

June 30, 1958

# Aviation Week

*Including Space Technology*

Swiss Design  
Mobile Missile

Computer Aim  
Is Fast Coding

75 cents

A McGraw-Hill Publication



Avro CF-105 Arrow



This model is a copy of the original design for use for use. It is the only one left. **LEONARDO DA VINCI (1452-1519)** genius of the Renaissance who wrote the first treatise on the mechanics of flight in 1500.

CONVAIR JET LINER

MASTERPIECE OF



Engineering

By affixing the ultimate in modern engineering concepts, Convairstar's Jet-Liner is the 20th Century realization of Leonardo da Vinci's hopes and visions of nearly 500 years ago. Fated and fated for the new jet age, the Convairstar Jet-Liner is truly a modern masterpiece of engineering!



A DIVISION OF GENERAL DYNAMICS CORPORATION

Among airlines that fly Convairstar Jet-Liner service will be: TWA, DELTA, TRANSCONTINENTAL, COMPASS, REAL AIRBORNE (direct)

FOR AIRCRAFT AND MISSILE APPLICATIONS:

# Variable Pump Design Breakthrough!

...by **VICKERS**

Variable hydraulic output from constant displacement package



NEW MINIATURIZED VARIABLE DISPLACEMENT 200 Series • Single - 3.5 lb.

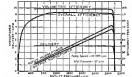


STANDARD CONSTANT DISPLACEMENT 200 Series • Weight - 2.5 lb.

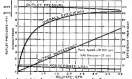
- 40% weight reduction—30% smaller envelope\*
- 12,000 rpm for aircraft applications
- 12,000 rpm for missile use
- 21,000 rpm for international duty
- 5.7 gpm delivery at 21,000 rpm
- 17 hp (over 7 hp/ft<sup>3</sup>) at 21,000 rpm and 2000 psi
- 90% volumetric efficiency—90% overall efficiency
- Less gears: Vickers 2000 psi rotating (paralleling element)
- External automatic pressure compensator
- Extremely rapid response
- Minimum external sealing elements
- Minimum number of moving parts\*
- Broad range of control methods available
- First of a new complete line
- Force saving (and back rejection) advantages of variable displacement at fixed displacement weight and envelope.

\*Compared to standard 2000 psi Vickers Series 27-2000 variable displacement and piston pump.  
For further information write for Bulletin No. A-5222.

Performance Characteristics of Model E 0011111 Pump (7.5-2000 30'Sm)



Curves show actual performance of new Vickers variable delivery pump. Note comparison to high volumetric and overall efficiency at throughout based on inlet pressure range.



Actual test data demonstrating high overall efficiencies even at partial flows for the new Vickers variable delivery pump. Note low horsepower loss throughout pump's delivery range.

**VICKERS INCORPORATED**  
DIVISION OF GENERAL DYNAMICS CORPORATION  
Aero Hydraulic Division  
Engineering, Sales and Service Office  
ADMINISTRATIVE AND ENGINEERING CENTER  
Department 1402 • Detroit 23, Michigan  
TORRANCE, CALIFORNIA • 2001 Lincoln Boulevard  
T.O. Box 9993 • Torrance, California



## PRESSURE POTENTIOMETERS

Beyond the Specifications...

the Total Engineering Story



Pressure Potentiometers, Type PR Series, measure absolute pressure of liquid or gases in ranges as low as 10,000 psi. Outputs available under vibration of 1 inch double amplitude from 2 to 20 cps, and 10 g from 20 to 1000 cps. Calibration fixed with all data points registered with each instrument and includes 2 mm in. dial and fulling process with and without vibration.

Specifications tell part of the story. At Trans-Sonics, Inc., they are only the beginning. For each basic design, three volumes of evaluation tests are available containing thousands of individual data points. Essential information on performance under temperature, vibration, shock and humidity is investigated, sifted out and recorded for easy reference.

This extensive data enables the user to quickly evaluate performance under new or unexpected environmental conditions. As a result, greater design freedom is possible and valuable engineering time is saved. Write to Trans-Sonics, Inc., Dept. 7, Burlington, Massachusetts, for Pressure Potentiometer Bulletin, or if you prefer, describe your operating environment and quantitative information will be provided.

# TRANS-SONICS

Precision Transducers

## AVIATION CALENDAR

(Continued from page 5)

- Aug. 7-8—Annual Conference, American Society for Quality Control, American Society for Quality Control, San Diego, Calif.
- Aug. 7-9—National Convention, OAS Club of Aeronautics, Hotel Statler, Los Angeles, Calif.
- Aug. 10-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder, Colorado, Boulder, Colo. Sponsored by: NAB, American Institute of Electrical Engineers and Institute of Radio Engineers.
- Aug. 10-11—Master Operations Research Engineering Seminar, Pennsylvania State University, University Park, Pa.
- Aug. 10-19—Annual Meeting, Beyond Vibration, American Instrument Society, Distinguished Aviators, Stanford University, Palo Alto, Calif.
- Aug. 10-22—Western Electronic Water & Composites Institute of Radio Engineers, Auditorium Hotel, Los Angeles, Calif.
- Aug. 15-18—North Atlantic Congress, International Astronautical Federation, Amsterdam, Holland.
- Sept. 1-5-1955—Framingham 7500g Display and Exhibition Society of Instrument Engineers, Framingham, Massachusetts.
- Sept. 5-6-1955—Cyprus Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.
- Sept. 6-13—First International Congress of the Astronautical Sciences, Palace Hotel, Madrid, Spain.
- Sept. 10-16—Fall Meeting, American Society of Mechanical Engineers, N. Y. C.
- Sept. 10-20—National Instrumentation Conference & Exhibit (International), Instruments Society of America, Philadelphia, Pa.
- Sept. 22-24-1955—Meeting, International Group on Vibration and Related Concepts, American Hotel, San Francisco, Virginia Beach, Va.
- Sept. 22-24—November's Annual Meeting, Standards Engineers Society, Sheraton Hotel, Philadelphia, Pa.
- Sept. 27-28—1-1/2-National Astronautical Visiting Society of Astronautical Engineers Inc., The Ambassador Hotel, Los Angeles, Calif.
- Sept. 27-28—1-1/2-National Astronautical Visiting Society of Astronautical Engineers Inc., The Ambassador Hotel, Los Angeles, Calif.
- Sept. 27-28—1-1/2-National Astronautical Visiting Society of Astronautical Engineers Inc., The Ambassador Hotel, Los Angeles, Calif.
- Oct. 6-7—National Symposium on Extended Range and Space Transportation, sponsored by the Professional Group on Astronautical and Propulsion, the Communications Section of the Institute of Radio Engineers and George Washington University, Washington, D. C.
- Oct. 7-8-1955—Joint Meeting, Institute of the Astronautical Sciences and Canadian Astronautical Institute, Chateau Laurier, Ottawa, Canada.
- Oct. 12-14-1955—National Vibration Symposium, St. Francis Hotel, New York, N. Y.
- Oct. 21-24—Annual General Meeting of the International Air Transport Association, New Delhi, India.
- Oct. 27-30—First Group Conferences on Avionics & Navigation, American Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.



The almost instantaneous return to normal of the new intercontinental Cat power unit under conditions of full-load application, and load rejection (117% rate), is shown in the above graph.

Load-fluctuations get power unit with slow voltage regulation is now being used in connection with general support for air-crafting and flying. The 400-cycle phase is specifically adapted to stability.

## Caterpillar power fires SNARK... first U. S. intercontinental missile

The U. S. Air Force SNARK SM-62, the first U. S. intercontinental guided missile, is fired with power from an electric set, developed by Caterpillar and now being supplied to the military.

The full designation of this specialized power unit is Caterpillar 60 KW 900-cycle 120-208 volt low-silicofence portable ground support unit with precision voltage regulation.

The secret of this unit is the almost instantaneous recovery to both applied and rejected loads.

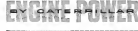
Other advantages found in all Caterpillar Engines include: trouble-free operation over a wide range of loads; dependability and long life; economy of operation; maintenance and operation by unskilled personnel; world-wide parts and service; and the ability to operate on any fuel from JP-4 through No. 2 furnace oil.

Creative engineering and quality of manufacture

have made Caterpillar the diesel leader for more than 25 years. For detailed information on the Cat 60 KW 900-cycle portable power unit with slow voltage regulation, send in the coupon below.

Engine Division, Caterpillar Tractor Co., Peoria, Ill., U. S. A.

Circle 10 on Reader Service Card



Dept. AWS, Engine Division  
Special Development People  
CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.

Please send me additional detailed information on Ground Support Units, Inc.

Name \_\_\_\_\_  
 Title \_\_\_\_\_  
 Room (or Firm) \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Date \_\_\_\_\_



## Save Time

*From Touchdown to Take-off*

Time on the ground costs money between touchdown and take-off. Any aviation product which can cut "hang time", cuts an airline's operating costs. Sinclair Aircraft Oils have earned the reputation for prolonging engine life - cutting maintenance. Proof of this is the fact that 49% of the oil used by major scheduled airlines in the U.S. is supplied by Sinclair. Isn't it time you, too, cut your cost of operation by using Sinclair Aircraft Oil?

### **SINCLAIR** AIRCRAFT OILS

Sinclair Refining Company, Aviation Sales  
450 Fifth Avenue, New York 20, N. Y.



## The Sword and the Shield

We have just feasted a taste of Europe and United States air combat units stretching along the entire NATO perimeter from Norway to the Black Sea, during the cruise trip we were seldom more than 10 minutes of MIG-19 flying time from Soviet air bases. This fact fosters a realistic approach to European defense problems by air combat units along the line Carthage to Suez, contrasted to the more literary, theoretical and optimistic approach too often found in higher headquarters in the West.

To Turkish reconnaissance pilots whose cameras look down at Russia and from high over the Black Sea and Caspian Mountains, to Norwegian seaward radar stations that look down into the vast Soviet air complex of the Kola Peninsula, and to all other NATO air combat units in the area in between, those extremes the problem of an adequate European defense, particularly against Soviet air attack, is no war college game. It is the grim reality of everyday living. We will report later in detail on what these forces are doing to improve their defensive capability but now it seems more appropriate to state some of the broad general conclusions on what NATO now stands and where it appears likely to go.

First it is vital to understand that NATO is only a part—albeit an important link—in the overall defense structure of the free world. There are other, though considerably less potent, defense alliances in the Middle East and Central to complement NATO's role in the containment of the Soviet bloc. But the most vital consideration in evaluating the current and future value of NATO is that it is primarily a defensive shield behind which stands the sharp-edged offensive sword of Strategic Air Command. The growing NATO land, sea and air forces would indeed be a paper tiger without vital links to Strategic Air Command's swift, global mapping capabilities striking power. Therefore the problem of increasing NATO's capability in relation to the Soviet threat is only part of the real and subtle problem of the West. Even more important is ensuring a significant and reinforcing increase in Strategic Air Command capability in relation to the Soviet air defense system.

This increase in SAC capability must come through wider dispersal of its forces, greater flexibility of its all-weather ability through more modern aircraft and more potent and greater efficiency through a more potent engine and lighter tared professional manpower corps. After bringing to a wide variety of NATO intelligence briefings on Soviet military developments, there is no doubt that the Commission here is increasing its offensive capabilities in all areas and modernizing its land, sea and air forces at a rapid rate that poses a genuine challenge to the future effectiveness of NATO.

The Soviets have converted their land armies from presently foot-slogging infantry to automated, armored and missile armed forms. The Soviet submarine building program is proceeding at an alarming rate with at least half the vast underwater fleet in being and abounding with long-range ocean-going types equipped with missile launching capabilities. MIG-21 Phantoms are now appearing in fighter squadrons operational units. The old submarine Beagle light bomber is pretty well phased

out of first line units and a supersonic heavy bomber replacement is well along for the Bison and Bear. Air defense missiles are appearing in greater numbers and of newer types.

Ballistic missiles with ranges close to 1,000 mi are now employed in Soviet launching sites both in Russia and some key satellite countries to bring most NATO air and naval bases within their range. The high level of Soviet air operational training level reflected on radar screens from northern Norway to the Caspian peninsula indicates a steadily improving capability in air defense and long range bombing techniques including radar bombing, aerial refueling and long range aviation.

All of this means that the pace of modernization for both NATO and Strategic Air Command must be accelerated if either are to be really effective against their potential opponents. There is little question that NATO modernization is moving at far too slow a pace to be even partially effective in relation to the growing Soviet threat. The lowest single estimate we based upon the various national air forces visited was forecast plus for some modern equipment capable of catching up surpassing their Soviet opponent.

There is no question but that the Pentagon and State Department policy of unloading second line USAF assets be sent to our NATO allies has long outlasted what ever original intention it might have had. Most of the NATO national air forces have developed considerable jet operational capability on the second line USAF equipment they were originally given. Although those are still serious maintenance and logistics problems in maintaining a high state of operational readiness for our NATO allies fighters, it is going to be increasingly difficult to tell the pilots who will have to fight first that they must be satisfied with second line equipment that will be received long after their Soviet opponents come through another modernization phase. This ribbon stricken and unrealistic policy by NATO European countries of their own air defense units is also another case point in the current NATO pattern. With expensive aircraft and missiles combined with the relatively small bases of many NATO countries, any air defense system that is not integrated economically now for the entire NATO area obviously could not possibly be effective against a determined Soviet air attack.

Although the Soviet military threat is now more powerful than it has ever been and is still growing, NATO is also facing problems of increasing political complexity in the Middle East and North Africa. These are insurmountable changes from European leaders including NATO Secretary General Paul Henry Spaak for development of political and economic capability to supplement military strength of the alliance.

But there is no doubt that NATO has been repeatedly successful in stopping the Soviet threat of the last decade and that it is an essential part of any future security pattern of the Western world. But it should also be quite clear that while NATO may be the shield of western Europe if a Strategic Air Command that is the sword that gives it meaning and makes it truly effective.

—Robert Holt



## B. F. Goodrich Fabric Tread Dimple Tire proved "far superior" in F-106 tests

Outstanding high performance runs were made on the F-106 built by Convair, a division of General Dynamics Corporation, just couldn't rate the possibilities. The stress of high-speed maneuvers and loadings heavily tore them to pieces.

Then B.F. Goodrich introduced its revolutionary new Fabric Tread Dimple Tire for testing. Even under severe operating conditions, including repeated SVO maneuvers, the tire proved that it could outperform and outlast any jet tire known today. As a result, the B.F. Goodrich Fabric Tread Dimple Tire is standard equipment on the F-106 Delta Eight, world's fastest and highest flying all-weather interceptor.

The amazing performance of the B.F. Goodrich Fabric

Tread Dimple Tire is made possible by two exclusive features. First of all, the tire has a built-in tread in the rubber tread stock to equalize the modulus between road and canyon. This cuts the amount of heat normally generated by flexing between the two elements of the case. In addition, the special Dimple Tread design eliminates stress points in the tread and therefore provides greater resistance to cracking and chipping.

B.F. Goodrich Fabric Tread Tires mean extra mileage, extra loadings, top performance stretch of all kinds. Available with either Dimple or Sawtooth Tread design. For more information, write B.F. Goodrich American Products, a division of The B.F. Goodrich Company, Akron, Ohio.



Cross-section of B.F. Goodrich Fabric Tread Tire shows how nylon reinforcement and built-in rubber tread stock. This unique construction provides extra resistance to road abrasion—checks the formation of dangerous high-speed shock waves. The Dimple Tread design is more subtle—helps reduce flexing and therefore provides greater wear.

## B.F. Goodrich aviation products



**EASTERN**  
**HIGH SPEED**  
**GEAR PUMPS**



SHOWN  
ACTUAL SIZE

Eastern Industries Hydraulic Pumps set new standards for performance, yet are the smallest, most lightweight ever made.

By meeting customer requirements and performance specifications with precise detail, Eastern Pumps give reliable long-term service. Hundreds of models, stem-coupled to drive motors with speeds to 24,000 RPM, can be furnished for your special systems. You gain the advantage of economical mass-produced components, precision-engineered into whatever configuration is needed. Performance is from .015 to 1.5 GPM, 5 to 2000 PSIG, with theoretical displacements from .002 to .0419 cubic inches per revolution. A variety of bearing combinations handle different types of fluid and operating pressures.

Missile and aircraft system engineers have discovered Eastern Pumps do the same job in even less space and weight for more. Applications have included providing coolant in bomber gas-turbine systems, providing hydraulic power for ground control of jet, charging accessories in air-to-flight refueling systems, furnishing an APU system with power to a missile, and countless others. For your next project, contact Eastern for custom engineering help that really helps.

Write for 1968 Eastern Bulletin 150 describing the above units and incorporating price.



**EASTERN INDUSTRIES, INCORPORATED**

100 64th Street • Boulder 14, Colo. West Coast Office: 1485 Centinela Avenue • Inglewood 2, California

### In the Front Office

John J. Schick, executive to the president in government marketing, Raytheon Miss Testing Co., Waltham, Mass.  
Prof. W. W. C. Johnson, of Precision Ultrasonic, a division, General Electric, Inc., Princeton, N. J. Also Shoney Machine, no title change.

N. M. Fawcett, second Harry W. Beck, half a president, National Automatic Tool Company, Inc., Rockford, Ill. Mr. Beck half continues in board chairman.

A. E. McCloskey, vice president marketing and K. J. Jans, vice president products, Westinghouse Electric Corp., Pittsburgh, Pa. Mr. McCloskey also will have charge of the Westinghouse International Washington, D. C. office.

Frank W. Walker, a vice president and management rates Materials Communications & Electronics, Inc., subsidiary of Motorola, Inc., Chicago, Ill.

John H. Kahan, vice president electronics division, and A. K. Schindler, vice president Dynco division, Instrument Corporation of Florida, Melbourne, Fla.

Carl J. Collier, vice president and assistant to the president, Copperhill Steel Co., Pittsburgh, Pa. Also Joseph M. Kennedy, Jr., vice president in charge of Separate Steel Division and Paul M. Farnough, vice president in charge of Ohio Sealed Air Tube Division.

E. D. Vinsel, vice president, The Cincinnati Midway Machine Co., Cincinnati.

Bo E. Kline, Jr., vice president/marketing, U. S. Steel Corp., Pittsburgh, Pa.  
George W. Hertzberg, vice president and director of manufacturing, Chicago Steel Industries, Inc., Lakewood Park, Ill., and Herbert W. Hoffmann, manufacturing manager, Alco Robert K. Lacey, Western industrial manager for the company's newly established Los Angeles office.

Edward J. Thompson, Jr., senior vice president and treasurer, Rabbit Airlines, Inc.  
David G. Fagan, computer, AEC Industrial Nuclear Products Division, Bethesda, Md.

E. J. Koenig, vice president and general manager, and R. L. Skimming, vice president electronics, Bellcore Systems, Inc., Fairfield, N.J.

Henry S. Gellay, treasurer, Hughes Aircraft Co., Culver City, Calif.

### Honors and Elections

The 1918 Hermon International Aviation Award winners, by outstanding achievement during 1967, are: Avrocar-Aero Car by E. LeMay, Vice Chief of Staff of the USAF and Avrocar-Craft Jack R. Stout (NACA) of the U. S. Navy Naval Air Development Unit, South Carolina; Miss N. award of the British Trophy was made by her.

Manufacturers Institute of Technology has awarded the Aviation World Fellowship for 1918-19 to Laurence Boudreau, an oil grinding student, who will receive \$2 1/2 in Academic Engineering in June 1918.

(Continued on p. 71)

Three merited graduate manufacturers bidding in the McDonnell south paper ballistic missile competition—North America's Avionics Division, Minuteman Instrument and Research—propose to use novel digital computer developed by Librascope, division of General Purpose Equipment Corp. New technique enables Librascope computer to begin new computations while it is finishing up the previous one.

Major breakthrough in helicopter rotor blade design tested by Vertel engineers in National Advisory Committee for Aeronautics could pave the way for future wing assault of the future to attain speeds of 270-350 knots, a performance never before was engineers up to severely streamlined body only by switching to conventional layout.

Navy's Bureau of Aeronautics is offering Kennel Aircraft \$11,000,000 contract for development of a vertical takeoff aircraft incorporating small size, flexible wings based in the trailing edges of the propeller rotor blades to achieve control in hovering and slow speed flight. Kennel has had a test rig operating under Navy contract for the past year comparing data on lift and control characteristics.

Army this year will initiate development of a medium transport helicopter designated Chinook, capable of carrying an internal load of three to four tons. Primary mission will be to provide short range tactical mobility for tanks, armored vehicles and other heavy equipment.

Radian Engineers heads for the door on Navy's T-12 turbo-torque motor will soon be fabricated with a precision casted turbine that will follow the cost of the cast at a savings of \$123 per foot. Heads have previously been fabricated with machine parts with critical tolerance. Navy also says adding auxiliary power only for the Turbine turbo-torque motor at an estimated cost of \$1,000 to \$2,000 per unit.

Higher Aircraft may gain the title of the nation's largest producer of defense electronics, pulling ahead of General Electric, by early next year when its sales rate will exceed \$125 million annually. Company has never thus doubled its defense business since management took of 501 years ago. GE says Thomas Hughes' position late in 1919 as its highest official early wiring system (BNC-155) activities expand.

Russia's Academy of Municipal Executive has developed a long range program calling for 4,000 transport helicopters for use in the USSR's major cities and for the construction of sea-to-land landing areas to accommodate them.

In the past 10 years, manufacture of Soviet metal working tools has been increased seven fold.

Vertel 75 tilt wing convertible vehicles will make a complete transition from vertical to high speed forward flight configuration in as little as three to five seconds. Converting T-55-powered craft has successfully lifted air wing forward approximately 10 deg and back to zero vertical in eight changing tests in Ft. Belvoir, Illinois.

Ames recently has awarded the first contracts for development of a new weapon system now designated Marder A to Convair and General Electric. Range and size of the weapon will fall between those of Honest John (15 in.) and Little John (5 in.).

Pre-cooling of nose to increase his tolerance to heat may be adopted prior to putting his through a high heat period such as takeoff for a speed flight or re-entry into the earth's atmosphere. Status of this technique and other matters of air's heat tolerance grounded on: Selected letter firm (with) will be available here or under web at Wright Air Development Center's Area Medical Laboratories.



# F105 USES *hi-shear* RIVETS TO SAVE WEIGHT RESIST HEAT AND CUT PRODUCTION COSTS



FEATURES OF PRODUCTION CONSTRUCTION MAKE AN ANTI-CORROSION RIVET STRONG AND A VARIETY OF MATERIALS TO JOIN. IT IS AVAILABLE IN 1/8", 3/16", 1/4", 5/16", 3/8", 1/2", 5/8", 3/4", 7/8", 1", 1 1/4", 1 1/2", 1 3/4", 2", 2 1/2", 3", 3 1/2", 4", 5", 6", 8", 10", 12", 14", 16", 18", 20", 22", 24", 26", 28", 30", 32", 34", 36", 38", 40", 42", 44", 46", 48", 50", 52", 54", 56", 58", 60", 62", 64", 66", 68", 70", 72", 74", 76", 78", 80", 82", 84", 86", 88", 90", 92", 94", 96", 98", 100".



THE F-105 IS THE MOST POWERFUL FIGHTER-BOMBER, DELIVERS nuclear and conventional weapons and incorporates some of the most advanced instruments in the aircraft art.



TO meet the critical strength and weight requirements of the Thunderbolt's structural components, thousands of Hi-Shear rivets are employed in a variety of sizes and material combinations to attach primary structural members, to resist elevated temperatures and to eliminate production headaches...



... typical Hi-Shear applications on the F-105B are shown above.

The Republic F-105B, the world's most powerful fighter-bomber, delivers nuclear and conventional weapons and incorporates some of the most advanced instruments in the aircraft art.

To meet the critical strength and weight requirements of the Thunderbolt's structural components, thousands of Hi-Shear rivets are employed in a variety of sizes and material combinations to attach primary structural members, to resist elevated temperatures and to eliminate production headaches...

© 1957 THE RIVET TOOL COMPANY, 210 WEST 34TH STREET, CHICAGO, ILL. 60618

CONTACT FOUR ENGINEERING DEPARTMENTS FOR QUOTATIONS, DRAWING SPECIFICATIONS, AND INFORMATION. WE CAN HELP YOU WITH YOUR RIVETING PROBLEMS. WE CAN HELP YOU WITH YOUR RIVETING PROBLEMS. WE CAN HELP YOU WITH YOUR RIVETING PROBLEMS.

**hi-shear RIVET TOOL COMPANY**  
210 WEST 34TH STREET • CHICAGO • ILLINOIS

## Washington Roundup

### Space and Congress

Congress are expected to meet later this week as each side tries to iron out differences between the House and Senate bills to create a National Space Agency. A meeting of the conference committee has been scheduled by the House, of Sen. Lyndon Johnson (D-Tex.), chairman of the Special Senate Committee on Space and Astronautics.

Major conflict between the two versions is whether the National Space Agency, of which National Advisory Committee for Astronautics will form the nucleus, is to be limited to a single director chosen by a 17-man advisory committee as proposed by the House or by a seven-man director board or an operating agency with a single director as the Senate approved. The House version is more in line with the President's recent instructions.

Meanwhile, the House Committee on Astronautics and Space Exploration has been holding closed meetings with great attention to an effort to create the parent clause which would be acceptable to industry as well as Congress.

### Cutler Resigns

Robert Cutler, President Eisenhower's controversial special assistant for national security affairs, submitted his resignation last week, but it may be termed "a little premature" since Cutler, 62, charged by his duties with office reorganizing from the President vital information on Soviet programs, will return to Boston to resume his chairmanship of the Old Colony Trust Co. He will be succeeded by Gordon Gray, 48, former director of the Office of Defense Mobilization.

Cutler's resignation was accepted by the President who asked his outgoing assistant for "some ideas" and the "deductions with which you have carried out your responsibilities." Cutler had assumed the post at the beginning of Eisenhower's first term in 1953, served until April, 1955, returned to Boston and then came back to Washington in January, 1957.

### Jat Request Denied

An American World Airways has been denied permission by the Civil Aeronautics Board to operate its Boeing 707 jet transport on a route and schedule during the period between delivery of the aircraft and completion of Civil Aeronautics Administration certification tests. Board ruling was based on a provision in its Bureau of Safety that such transports should not be operated "at this time" for competition on line.

### Subsidy Debate

Chambers of congressional approval of proposed legislation to provide domestic aviation from going back on subsidy do not appear likely during the current session of this year. Public hearings have not yet been announced by either the House or Senate committee committees studying the subject, and time is growing short and the mid-June adjournment. In addition, the Air Transport Act had decided not to support the proposed Senate tradition with big jet commitments and low profits also will apply it.

Strongest support comes from the big domestic car-

riers who have long criticized the Civil Aeronautics Board for permitting "multiple competition" on high density routes. FAA June 2, p. 11. Bills to eliminate double seatline competition for inland passenger routes were introduced by Senator Strom Thurmond (D-S.C.) and Thurston H. Martin (R-K.) and Representative Peter J. Vukob (D-Ill.) and John F. Moss (D-Calif.).

### Excise Tax Repeal?

Senate House conferees last week agreed with the Senate on repeal of the 3% transportation tax on aircraft, but passed down another proposal supported by the Senate to eliminate the 10% tax on transportation of passengers.

An amendment to repeal the tax was offered by Sen. George Sullivan (D-Ill.) and approved by the Senate Civil Aeronautics subcommittee on transportation and excise tax rates one vote. It was the only change approved by the Senate in the bill which had passed the House earlier. Repeal of the transportation tax was strongly supported by the railroad, trucking and airline industries.

### Close Shave

Motion picture in the negotiation of Robert L. Koenig is expected to assist in the direction of the Civil Aeronautics Board may be defeated by a tie vote out last week at a special meeting of the five airlines based on "Member Louis F. Hector offered the airlines after Koenig was accused of illegal financing a United Air Lines aircraft with "retention" because of congressional testimony given by United President W. A. Patterson who criticized CAA policies (AVI June 16, p. 29).

Members Herman Oeger and Hector voted for the measure while Chairman James Douglas and Senator C. Joseph Wright opposed. Vice Chairman Clay Gurney advanced from being losing, he said, the chairman had the power of authority in the end.

### Gurney: Bid for Second Term

Memorable, a bid by Vice Chairman Clay Gurney to obtain a second term of office on the Board was made last week, without an apparent opposition from the Senate Commerce Committee. Although the committee which heard Gurney testify on open hearings on his confirmation failed later to touch on his appointment to the Board post or on executive actions, Gurney is expected to gain unanimous committee approval during the next legislative session (AVI 6).

Gurney first took office on March 12, 1951, and his term expires Dec. 31.

### New Energy Sources

Space vehicles will be able more than "existing devices" which scientists are developing extremely lightweight, highly reliable new electrical power sources, says Gen. Milton C. Doolittle told a meeting last week of the American Institute of Electrical Engineers. Doolittle, deputy commander of the Air Research & Development Command, said advance of such power in space is essential to solve the major problem of electrical energy to electronics. By the end of the decade, he said, "we should deliver 250 kilowatt hours per pound of equipment."

—Washington Staff

# United Aircraft Gears for Space Role

Corporation reorganizes to reflect missile, space weapon system management capability it possesses.

By J. S. Bate, Jr.

**Hartford, Conn.**—United Aircraft Corp. reorganized its structure last week to reflect the missile and space weapon system management capability that it has been building quietly for the last several years.

Focal organization of United Aircraft on this role will inevitably increase in tandem with the corporation's prime contractor responsibilities as the developing number of space weapon systems. The corporation divided into two divisions—the Missile and Space Systems Division and the Norden Division—the first in drawing technical and scientific personnel from existing United Aircraft groups and the second through the acquisition of the Norden Ketter Corp., a well-established electronics company.

Nucleus of the Missile and Space Systems Division (MASS) is about 200 specialists from the newly transferred electronics department of the Hartford-based Division of United Aircraft. This department was formed over two years ago primarily to coordinate and improve the corporation's abilities as weapons system planner. This group has been preparing itself for the move to completely manage scientific missile systems projects for over a year now. It was also involved in the Selma competition but its staff being combined in other divisions. Personnel for the work now rests with the new division which is headed by Wright A. Feltus, who still retains his position as United's vice president for engineering.

United officials indicate that for the present the MASS division will concentrate its efforts on missile systems but the large development facilities for non-aircrafting weapons that are being built at Florida will indicate that work more involved work is contemplated.

General philosophy of United management regarding future weapons and space vehicles was also announced as part of the reorganization. The firm's 20th anniversary. Although new and important discoveries are constantly being made, they believe the next two or three generations of operational weapons and vehicles will require responsible systems of present systems.

Of the five "billions dollar" contracts here, United is the last to seek prime contracts for advanced weapon systems and vehicles for atmospheric and space use. Main reason for this appears to be the fact that United's primary product

the powerplant has only recently been considered for the major important component of any aerial vehicle. The powerplant on space vehicles in the east coast and different component to develop.

H. M. Hester, chairman of the board also indicated that the announcement of United's new business course was withheld until the capabilities actually formed. He feels that prime contractors are not interested in a company that is in business in the coming years but that it is important to keep a big company big in the future.

President of Norden Ketter, effective July 1, presides United with a group of several hundred scientists which has long experience in a variety of science specialties. Norden Laboratories, formerly a division of Norden Ketter, will become a department of the Norden Division of United Aircraft. Norden Laboratories is presently developing and/or producing equipment for the guidance and control systems of the Altus, Titan, Taurus, Taurus, Sparck, Redman, Jupiter, Atlas, Scout, Regulus and Polaris missiles. This equipment includes analog/digital converters, precision time measuring systems, automatic instrument drivers and boost division control among many others. The boost division works with aircraft a closely related to an inertial guidance system and the major Norden Laboratory services are provided for various aircraft by United as the guidance system.

Earle Martin, United vice president and former president of Norden Ketter, indicated that the new division is a direct line of the overall operations of the Hartford-based and Norden divisions. Highly classified Norden Ketter specialties included a Nuclear Scrammer and Engstrom Corp., a 7000-ohm solid state

ray which provided scanning service to include, a group specializing in the very small vehicles and other rotating electrical devices which will become the Ketter department of the Norden Division. This system Division which has a substantial civil as well as military business and will become the Data Systems Department of the Norden Division, and a small gas compressor. All of these operations will continue to operate in the past except for top management provided by United.

Martin will be assisted by Robert A. Appenfeld, former assistant general manager of Raytheon, who has been named the general manager of the Norden Division. W. P. Hunko, who is the assistant general manager of the Norden Division, was named as interim manager of Hartford-based Hamilton Standard's new general manager as Charles M. Kozak, Jr.

In commenting on the Norden Ketter position, Martin pointed out the importance to United of retaining two of the best known Norden Ketter scientists as L. T. E. Johnson, who has functioned in a special advisor to our government, and John G. Williams, former head of a work organization for his work with aircraft and missile systems.

H. M. Hester, chairman of the board of United Aircraft, during a discussion of the corporation's future operations, said that the Missile and Space Systems Division was not an operating division. He indicated that it is a group of people who are completely devoted to the corporation and the concept of a research unit manage the development with the design and construction being assigned to the other divisions.

United's present operations include a wide range of weapons system development projects. These capabilities must closely meet the existing need.

United's current expansion of its operational and development facilities is a vital part of weapons system development projects.

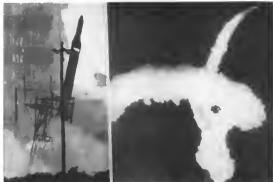
Pratt & Whitney's new Florida facility is engaged primarily with the development of the F100 turbofan engine at present but it will soon have the capability to not only large rocket engines. It will also be used for the testing of rocket fuels.

The contractor will facilities maintained by Pratt & Whitney at its Willoughby Laboratory in Connecticut are also being expanded. The large aircraft but divisions there could only be modified toward terminal use, as no new or other units of the same general use. As the modern powerplant could also be operated during the test, the facilities would be especially valuable.

## Chief Scientist Chosen

Along with its formation of a new division, the space and missile field test unit, United Aircraft Corp. named the late John W. Pratt, recently engineering manager for the Ford and White Aircraft Division.

Pratt will continue the organization's advanced technical projects in missile and nuclear needs. He will work closely with engineering and design groups of all the corporation's divisions.



## Polaris Guidance System Checks Out

Launching of test vehicle for Navy's Polaris first ballistic missile from the Air Force Mark Two Cruise, Cape Canaveral, Fla., last week marked the first check-out of the missile's guidance system. Test Polaris began possibly will be that of a fully automated and downward glides and to see from its original launch height. Portions of the test was to determine the response to ground signals of the guidance system which was developed by the Massachusetts Institute of Technology. Test being programmed for 21 sec. duration.

## Army Evaluates Data From Explorer III

Washington, Ariz., reported last week that preliminary reduction of data received from the Explorer III satellite, indicates that some ionospheric penetration within a mean velocity of "about 100 miles per hour."

In a report on the satellite, which by late 1960 had traveled an orbited 12 million miles since its launching on March 26, Army said the data received on the storm that caused ionization at higher altitudes is considerably more intense than had been previously anticipated and that atmospheric density is contained in several times greater than expected.

Plasma sources of Explorer III, which is late last week was nearing the point of re-entering the earth's atmosphere, was to make a comprehensive series of the total cosmic ray intensity about the earth with respect to both time and position. Instruments for the project was developed by the State University of Iowa Physics Department.

Launched on a slightly eccentric orbit which brought its path down to the earth, this orbited, the satellite originally had an apogee of 1700 mi. and a perigee of 117 mi. In last week, the perigee had dropped to 99 mi. In the space, which was falling at a rate of 60 mi. per day, to 375 mi.

On May 7, two of the Explorer's electronic instruments began to fail to measure space data were captured by measurements of the Eta Aurigae nebula, which occurred about the orbit of Heron's Comet.

Explorer I last week had traveled approximately 91 million miles since its launching on Jan. 31. Since that time, its perigee of 223 mi. had dropped only five miles. Lifetime is estimated at about seven years.

## RCA Wins Contract For Army System

Washington—Radio Corp. of America has won Army Modulation-Based competition to develop an experimental automatic air-ground communication system (AGACS),

beginning on 11 of its capabilities. Terms of the contract, which AMB is negotiating with RCA, calls for delivery of a trial experimental equipment by July, 1959, for testing with the data processing system being developed in AMB's General Purpose Laboratory. Flight tests are scheduled for 1960 in the New York area.

The AGACS data link is expected to greatly reduce air-ground communications by enabling ground traffic controllers and pilots to exchange routine messages by means of push buttons (AW May 24, p. 34).

The four-ton multi-plexer technique which RCA proposes to use is believed to be feasible to use employed in the military data link, enters the company is developing for Air Force and Navy.

The AMB system will be designed to use existing and VHF or ultra-VHF transmitter-receiver, space, either single-channel simplex or double-channel duplex. System is expected to be able to transmit up to 150 aircraft per minute, provide a 99.9995% error free error transmission per aircraft per year.

# Mars, Moon Bases Foreseen in 20 Years

By Irving Stone

Los Angeles—Mars and Moon will have permanent manned outposts in 20 years, Brig Gen. Hinson A. Boushey predicted here at a symposium on possible dramatic space operations in the Air Force Office of Scientific Research and Accep-General Corp.

Boushey, deputy director of research and development and deputy chief of staff for development, headquarters, USAF, pointed to the record of past space "coasters" and the forecasted "cruiser" to blame for much of the past, as his prediction of potential accomplishments for the new space era, which would require faith, imagination and courage, he indicated.

Because of the lesser gravity, air and more gradual deceleration cycles, though the atmosphere of Mars would be more than twice that of Earth, Boushey declared. Surface temperature of Mars sea level would be about half that of Earth, and a few years of protective engineering could provide a suitable habitat against the extreme cold at night, he said, adding that perhaps the atmosphere will be of such composition that it would only have to be reprocessed for use by man, and that enough water probably is present.

Regrettable qualities appear to be stored during the voyage. Estimates of duration range from 75 days to as long as 244 days, depending on orbit. Keeping man alive during that voyage is difficult, closed-circuit conditions are an obvious risk, he said, but all other aspects of establishing a habitable site on Mars seem to be no more than a technical problem.

Boushey again raised the controversial question of the probability of a lunar base. If food, the availability of a lunar base in a relatively small, accessible, volcanic crater could greatly benefit mankind.

"I for one would not like the chance to go to a site that the moon is a superb habitat site, for in fact we are determined to do this. I think we at the Service feel that same."

Commenting on the practical use of each satellite which would provide establishment of permanent systems on the moon and Mars, Boushey declared that "either enable TV" will provide enough resolution to determine local coverage and accompanying need patterns for those viewing and accurate assist weather prediction.

For communications, Boushey said, a major effect of any type of satellite might be used "I refer the power, or reflector satellite since all the payload could be devoted to the reflecting sur-

face. There would be no power supply problem or electronic failure to cope with and during the very extended period it would remain in orbit—perhaps thousands of years—it would function."

Radio type of communication satellites would require messages in direction of Earth from New York, then then on tape, and approximately 15 min later, over Paris, the satellite would give out the message addressed to that location and at the same time receive a batch for delivery to other cities, Boushey declared.

In the case of a communications satellite, speed of delivery of the message would make a two-circuit circuit would distribute even though non-direct air energy would be required to place the satellite in orbit, Boushey said. Diffusion in ground speed between the atmosphere of Earth and Mars, and increasing altitude, would be 2,000 mph, or twice the earth's rotational velocity. At an orbital altitude of 1,000 mi, for example, there is about four seconds' delay in the message. The more the orbit, the more the delay, but for one orbit of the globe would be 1 hr 45 min.

Other practical orbiting applications include geostationary satellites and polar orbiting satellites.

Polar orbits can be used for a satellite (and as a space vehicle because a polar orbit would be normally used for bombardment, he declared). The increased speed would be 3 hr, while some 100,000 sq mi of Earth's surface could be covered in one orbital revolution of space in orbital distance, there is not the overwhelming expense as for a military space application.

Progress in advanced systems on an orbitable closed space, making it faster approaches in orbiting propulsion, was co-chaired by Dr. Martin Aepfer, director of electrical studies, AFOSR, and Dr. D. L. Armstrong, manager, Accep-General's Chemical Division.

Results of an experimental study of kinetic radiating propulsion of free radicals in a closed space, the data were obtained by T. M. Shaw of General Electric's Microwave Laboratories. Simple waveguide systems can be used to create a microwave discharge in a closed space, he said. Studies of free radicals produced in the discharge was measured by metal accumulation plates and by electron paramagnetic resonance spectroscopy.

From an increase in power on a yield of free radicals discharged that, radiating production goes up almost linearly with power, there tends to increase and fall off. This indicates that there is a maximum of power which can be used eff-

iciently in a particular size of discharge tube and concentration of additional power is wasted.

It is necessary to keep the discharge tube cool, since low radical yields fall off substantially if discharge tube is hot. Best yield of free radicals occurs at a pressure of about 0.5 mm. This is declared. Lower or higher gas pressures result in reduced yields.

If a free amount of microwave power, the rate of increase of yield increases with the free rate up to a limiting value, after which the rate increases little so appreciable increase in the number of free radicals. Hydrogen atoms are inherently easy to produce in high concentration with microwave discharge, indicating feasibility for possible propulsion use, but purification of free radical distribution is important in the moving propellant, as a criterion in the approach to use free radicals for propulsion, Shaw said.

General Electric research on the production of free radicals is supported by Department of Defense through the Office of Ordnance Research, U. S. Army.

Relatively simple ways to produce free radicals in condensed phase of gases and vapors, he said, have been developed by H. A. Pappas, General Scientific Research Laboratory. The method involves free radical discharge, which produces and accelerates the ionization of the gas. While some experiments show that both positive and negative ions are present in the ion beam.

If the negative ions are assumed to be electrons, estimate of their energy yield is equal to or less than 20 eV. No estimate of the energy of the positive ions could be made. Papers presented because of the high rates of the available negative field. Feasibility of all-out orbit stabilization in mobile concentrations is indicated in free radical studies at the National Bureau of Standards, conducted by Robert D. Behr.

Hydrogen atoms, produced on the surface of hot tungsten filaments, react readily with certain alcohols condensed at room 195°C. Of eleven investigated compounds, he said, only two were found to react (ethyl alcohol, and acetone) through hydrogen uptake. Before reduced (butadiene 1,3, pentane and 1,5, ethyl benzene), most very slowly react with hydrogen and hence show an irreversible reaction. These rate differences are attributed to small differences in selective reaction which are studied continuously at the low temperature.

Members of the scientific associa-

tion include two associate hydrogen atom scientists as well as all radical radiating, resulting from hydrogenation of the alkyl, is further hydrolyzed to the alkyl, solvent dissolved.

Main points of an experimental investigation of luminance of solids produced by surface accumulation of free radicals were presented by Kenneth M. Swartz and Henry W. Stuehli, Research Institute. This research is projected to receive basic knowledge of radiolysis-induced chain crosslinking and other chemical reactions inside and gases. Also, in population systems it may lead to the reduction of high surface temperatures associated in liquid rocket.

Theoretically, this transfer of energy requires an overlap of electronic energy levels of the radiating solid, rather with those of the solid, Swartz associated with the light.

In order that transferred energy may be converted to light, the energy levels of the solid must be non-intersecting in a sense of ion transitions.

Checking properties of an ionizing source, Swartz said that intensity and spectral distribution of the luminance of a solid irradiated by these sources will be measured, temperature effects will be studied, and absorption spectra of solids compared with energy levels of atom systems.

Surface energy levels in luminescent solids can be regulated by measuring the absorption of low energy electrons of ions in the range of 0.1 to 10 eV electron volts, Swartz noted. Solid phosphors will be selected from organic and inorganic substances, incorporating a wide range of materials.

Analysis of ion sources was presented by R. J. Staudenrafer of Accep-General Corp.'s Astronautics Laboratory. Recently gas-filled space vehicles will require small ion currents ranging from several hundred to several thousand ampere. Source of their ions must be capable of continuous operation for periods extending to several earth years. Such a source would be composed of a large number of cathode ions, each having high ionization energies, high ion efficiencies, and high rate to neutralizing electron return. Swartz declared that, ideally, the unit must be flexible enough to allow the current to be varied over a wide range, and light enough so that the complete source could be easily moved in the unit.

Scattered around these main points:

- Of cutting methods of producing ions, only independently discharge source and highest pressure source appear applicable to propulsion.
- Main difficulty with emitting sources is that energy required to produce a single ion is very large—over 1,000,000 to fill electron volts per ion.

• Unconventional "magic membrane" source (IAW April 3, p. 61), which he described, relies on a process of producing high charge-to-neutral particle emission ratios.

• If hot filament or arc is used to produce electron emission, pressure must be made low (vacuum) applications.

• Careful design of cathode apertures will be necessary to insure that intensity of emitted ions can accurately through the accelerating plates. This problem becomes increasingly difficult at low accelerating voltages and the large fraction of the emitted ions are not captured increases overall power requirements.

• Electronic materials must be able to withstand ion bombardment for long periods of time.

• Limitations imposed on the ion rate in space charge may be overcome, to some extent by varying size of opposite charge into the space charge region.

Necessity of neutralizing the ion beam will place ionizing charge criteria based on the accelerating and ion extracting systems.

Ion source consisting of a "magic membrane" which would, upon exposure of neutral and charged particles and which would allow only charged particles to traverse the membrane, was outlined by Staudenrafer.

One description of such a source,



**Boeing Develops T60 Gas Turbine**

Boeing Airplane Co. recently began test cell work on its T60 engine being developed by New Britain of Connecticut in partnership with a helicopter corporation. The T60 engine is the highest pressure turbo engine ever achieved in a single-stage compressor design. Compressor action is driven by a single stage axial turbine turbine wheel. Designed in a simple, low-cost, ready-to-mount engine, the T60 employs variable axial geometry on its compressor action to guide the flow of incoming air, giving efficient operation over the full operating pressure range from idle to maximum output at altitude. Weight of the full engine is 120 lb. The T60 is an outgrowth of the Boeing T44 series.

# Slow U. S. Rate of Modernization Criticized by Army Deputy Chief

By Fred Ertman

Washington—U. S. is taking a major step in curtailing the low rate of re-equipping the Army's postwar force with tactical missiles and other equipment on the line of Soviet modernization of its forces, the Senate Appropriations Committee was warned last week.

Maj. Gen. Frederick J. Brown, Army assistant deputy chief of staff for logistics, programs and budgets, said the U. S. has traditionally relied upon technological superiority and numerical superiority to offset the advantages of numerically larger hostile forces but that both the technological and numerical superiority of the U. S. has been challenged since the late 1940's.

Gen. Brown said the equipment program through the Army, procurement of equipment and missiles approximately is being reduced at a rate of about 18% a year through reductions in training, research in use and obsolescence.

About \$600 million is estimated as postwar training and \$540 million is needed to replace obsolescent or obsolete ordnance assets annually and \$200 million is used for new equipment acquisition in development and testing, he said.

Gen. Brown said that, while the fiscal 1970 is not the budget year for fiscal 1970 as adequate to provide for these losses and gradually modernize the current inventory, it will not prevent a higher rate of modernization or improve the effectiveness of the high priority equipment requirements necessary to support the war plans.

## Missile Program

Out of the \$1.6 billion requested for fiscal 1970 and the \$218 million contained in the amendment which will permit a modest increase in modernization, Brown said the major funding deficiencies must be corrected immediately.

- **Redstone—\$199 million** for ground equipment and missile systems.
- **Sergeant—\$44 million** for warheads, ground equipment, missiles and test and target items. The Sergeant will eventually replace Corporal in the Army's arsenal.
- **Lance—\$36 million** to be obligated for ground equipment and missiles.
- **Honest John and Laffin John—\$17 million** expected to be obligated for Honest John warheads and Laffin John rockets and warheads.
- **Deer—\$34 million** expected to be obligated for ground equipment and missiles.

## Army's replacement missile program includes

- **Nike Hercules—\$160 million** for ground equipment and missiles.
- **Nike Zeus—\$176 million** to be obligated for maximum effort on development of Zeus as a defense against Soviet ballistic missiles.
- **Thor—\$211 million** to procure ground equipment and missiles.

## Aircraft Program

- **Army's program for helicopters and other aircraft includes:**
  - **Sikorsky H-32 Mojave** medium class helicopter—\$78 million to buy 34 Mojaves, a large transport type with a three-ton payload.
  - **Bell UH-1 Iroquois—\$51 million** for the procurement of 60 that in a utility type helicopter with a 1-ton payload, used to forward medical units for cargo and personnel in operations of ground units.
  - **Bell OH-59 Kiowa—\$11 million** for 15 reconnaissance helicopters of the light weight, two-passenger type.
  - **Grumman OH-1 Mohawk** medium observation aircraft—\$15 million to purchase 31 airplanes. Mohawk possesses high maneuverability, shorter takeoff

and landing characteristics and is used in platform for electronic gear to pinpoint targets for longer range weapons.

- **De Havilland Beaver** utility class aircraft for use for personnel and 100 of the one-half ton utility airplanes.
- **De Havilland U-5A Otter** cargo or utility—\$1 million for 20 of the one-half ton cargo planes.

Chief tactical aircraft division in the Army's fiscal 1970 procurement program include:

- **Douglas navigation systems—\$15 million** for the procurement of 151 of the most advanced air navigation systems to provide both helicopter and fixed wing pilots with a means of determining their exact location at all times.
- **Douglas helicopter systems—\$20 million** for 1,800 units. This is a device that increases the number of elements that can be placed on already existing rotor and was current in total type of four up to 16.

Chas. Brown said the Senate Appropriations Committee said the 51% cut in sales reduction to spare parts for the Army aircraft program will seriously affect the maintenance of equipment assets through a reduction in spare parts caused by reduced supply support. He said the Army's estimate of \$11.4 billion for spare parts during fiscal 1970 is based upon current support requirements for the Army to perform its mission most effectively.

# Boeing Seeks Long-Term Funds

New York—Boeing Airplane Co.'s long ranged search for additional financing has been far less well known than the board of directors authorized an offering of \$30,000,000 in 22-year convertible subordinated debentures to equity investors in 1964. The company's non convertible working fund debentures to the public.

Financial analysts have said the offering was one of the largest, if not the largest single package ever floated by an aircraft company. The financing is necessary because of increased cash demands made by the 747 jet transport program and the company's current program projects.

Other financial developments:

- **Watkins Aircraft Co.** reported that net income for nine months of the current fiscal year increased to \$4,712,187 compared with \$3,544,488 a year ago. This was despite a decline in sales from \$24,478,566 to \$191,678,444. Earnings per share for the three months was \$2.99 compared with \$2.31 a year ago.

Increased efficiency and cost cutting accounted for the increase in sales. The company, an operating the sales drop, said the Stock \$34.67 while

market has not been entirely in sufficient quantities to take advantage of the offering. Analysts added that the T-38 response program had been stretched out.

- **Solar Aircraft Co.** earnings for the first nine months of the current fiscal year were \$1,595,466 on sales of \$78,700,000 and earnings per share were \$2.32. For the previous year earnings were \$1,691,501 on sales of \$81,116,545 and per share earnings were \$2.05.

- **Boeing Aircraft Corp.** sales rose to \$11,914,000 for the nine months ended April 30 from \$10,802,000 for the same period last year but earnings fell to \$2,508,391 or \$2.68 a share from \$1,781,743 or \$2.68 a share for the comparable period last year.

- **Avco Manufacturing Corp.** net earnings rose to \$6,210,465 for the six months ended May 31, a 19% hike above the \$5,272,621 reported a year ago. Sales in \$148,218,457, from \$145,025,239 in a similar period last year. Deloitte banking as of May 15 was \$225,000,900. Avco is parent controller for Titan ICBM, auto cone.



Republic F-105 Pops Drag Chute

Republic F-105 Thunderbolt releases its drag parachute on touchdown. Note that while the chute pulls the air plane into a steep climb the pilot was being pulled out behind nose up, the top and bottom panels are attracted. This configuration gives the drag chute less a drag area than when pulled.

# Semiconductor Devices of Future May Replace Complex Circuitry

Many IBM, N. J.—Victory of novel semiconductor devices capable of generating functions not now possible with transistor was predicted by Bell Telephone Laboratories officials during observations of the 10th anniversary of the discovery of the transistor.

Solid-state devices capable of performing complex circuit functions within a single physical structure the size of a transistor, such as a miniature of optical circuitry and very high antennas, were predicted by Dr. J. A. Morton on the basis of quantum theory progress. Morton is director of ETL's device development.

Digital computers with 10 to 100 times the speed and complexity of now available are being developed to solve new problems" may result from a newly discovered semiconductor effect, Morton said. It electronic voltage

breakdown in a PN junction can be confined to a single microscopic region, a device known as a quantum-dot semiconductor device. Morton said application of this effect could provide a new type of semiconductor amplifier, for both continuous wave and pulse use. This can operate in the millimeter region and provide computer switching speeds of 100 to 1,000 ns.

Another novel low noise microwave amplifier, which uses germanium or silicon PN junction diodes as variable capacitance amplifier, has reported at Fairbanks as high as 5,000 c/s. Morton reported. A high-frequency pumping signal amplification circuit. The device has radiated a bandwidth of 1/2 sec, gain of 15 db, and noise figure of 7 to 8 db with pumping signal of 12,000 ns.

Army of several such devices in a traveling wave amplifier configuration

large amount of providing bandwidth of 15% or more in the ultra-high frequency region, Bell officials say. One such laboratory device has provided a 100 ns bandwidth at 400 mc signal frequency, with gain of 10 db and noise figure of only 15 db. Variable capacitance diode amplifier can amplify, at low frequency, low high microwave signals down to dc. Noise figure decreases as operating frequency is increased.

# British Avro Missile Discarded by Soviets

Moscow—Russian military publications were confident that the Avro missile looks like and apparently copies of British avionics indicate copies which first centered around the Canal jet transport failure and gas leader after last year's "disappointing" Society of British Aircraft Constructors show at Farnborough.

Red Air Force intelligence is now post-pooling British claims regarding the Avro jet to further missile design for use with MiG-21 and MiG-23 fighters (AW May 17, p. 91). In a case, members told "It is something new," the official Russian Air Force newspaper Sovetskaya Aviaciya says that the Avro missile looks like and apparently has the same dimensions as the American GAM-67 Rascal. It adds.

"Despite indications that the Avro missile range cannot be great because of large fuel consumption, the British press has raised a doubt about the new missile. Purpose of this propaganda campaign is to give wide publicity to the Avro company and at the same time to puff the achievements of the British industry."

Soviet Union Avroists possibly observed that "other countries" strategic interests (obviously referring to Soviet interests) have been engaged with guided air-to-air missiles for some time."

## Subroc Contract

Washington—Navy announced today that a \$61 million contract for the development of the Subroc submersible missile system has been awarded to Goodrich Aircraft Corp. in Newport News, Va.

Subroc missile may be fired from above or below the water. It is submersible in the water, the missile can sit on the water, launch through the air and then re-enter the air on the target altitude. Leaving the water for a portion of its flight greatly adds to the range of the missile. The Subroc system calls for competing contractors bid in with some agreement which will automatically bid subcontracts, plus their own and spend out for the missile in the program.

Effective "all" may proceed on subcontracts until completed with the Subroc system as described by the Navy as "a very quiet case."

Funds appropriated by the Subroc system are intended for further research and development production studies and Subroc development work to date has been handled at the Naval Ordnance Laboratory, Newport Sping, RI.

Contract in prime contract for Subroc will work with contractors at the facility. Principal subcontractors are Lockheed, Grumman, and the Kinetics Co., Chiles, N. J.

# McElroy, Russell Clash on Defense Bill

By Katherine Johnson

Washington—Strong opponents in the Senate to the President's proposal for reorganization of the Defense Department broke into open dissent last week.

In the brightest act of challenge by Sen. Richard Russell to Defense, Senator Neil McElroy cast possible reprisal against military officers or officials who present views to Congress that are not in line with the President's program. Russell's challenge was touched off by the testimony of John A. Mohr, chief of aerial operations, before Senate Armed Services Committee on which Russell in dramatic fashion supported two provisions included in the reorganization plan which passed by the House by a vote of 402 to 1. These were:

- Repeal the Defense Secretary's authority to reorganize the defense and service secretaries. Under the President's plan, the Assistant Secretaries of Defense would be expanded to give control to the service secretaries (AW page 23, p. 27).
- Put limits on the President's authority to transfer or abolish "major" combat functions of the services by providing for a congressional veto.

## McElroy vs. Russell

Of Russell's testimony, McElroy said: "I am disappointed in him, regard it as regrettable. I think he is a fine officer, but there are some things in this respect" McElroy said he had no plan to change Basic's views but added that he is "not the only one" responsible for the rapid climb of Basic. Russell generally attacked by asking probing questions before his conviction of other active military leaders which McElroy justified "due and appropriate" reasons. He said that there would be an approach. A prompt telephone assurance from McElroy did not comfort the senator. Later, McElroy did mean Basic is writing that no account can be taken of "any speeches or resolutions or press."

Russell and McElroy's earlier conversations concerning John A. Mohr, an "idea" spokesman that the chief of staff need confidence to be proposed. This is more in keeping with the traditional concept of government than with our free government of elected power.

"The Senator's admission that he had asked the military chiefs together and advised them that their testimony to the committee of Congress must be given in the light of their knowledge of the views of the executive branch creates a grave doubt as to whether

the Congress can get the free and frank opinions of these men on legislation. A witness standing under the sword of reprisal will find it difficult to give his honest views."

The Basic episode formed on a third provision of the House-approved reorganization legislation to which the President has vehemently objected. This authorizes the service chiefs of staff and secretaries to present views to Congress in addition with the President's position after consulting the Secretary of Defense.

President Eisenhower charged that this provision "erodes independence to the President and Secretary of Defense, violates the idea of democracy and blocking of defense reorganizations suggests that Congress hopes for the obedience and subservience of the chief of staff and the service secretaries."

Russell declared that McElroy's case rests on facts or "strong proof" of the necessity for the provision.

Meanwhile, there were three two other episodes.

- Sen. Styles Bridges (N. H.), leading Republican member of the Armed Services and Appropriations committees threatened to "vote hell" over the President's plan to reorganize the congressional liaison offices of the three services in the office of the Assistant Secretary of Defense for Public Affairs. "I don't intend to have to traffic down through the office of the Secretary of Defense and have my right to contact the services' secretaries" Consolidation of the secret liaison and information office is now moving forward (AW page 23, p. 27).

- Two Senate Members, Sen. Mike Mansfield (D-Mont.) and Sen. Paul Douglas (D-Ill.) circulated among their colleagues a memorandum denouncing the President's reorganization plan, also a list of "including provisions of the House-approved plan that were accepted by Basic. The Mansfield Douglas memorandum threatened that over the reorganized military, to transfer or abolish combat functions provided in the House measure as "an unconstitutional."

Other developments included:

- Gen. Thomas D. White, USAF Chief of Staff, was told by the President in his objections to the House version. If a chief of staff has views contrary to the President and feels it his patriotic duty to express them, White said he should write him and then do so. White objected that under the House measure one member of the Joint Chiefs of Staff would be in a position "to impede a proposed change or suggestion by virtue of his unilateral opinion that a combatant

function is a more important function. This could hold up action for some months on a change of major importance to the security of our country."

- Sen. Stuart Symington (D-Mo.), first Secretary of the Air Force, also announced full support of the President's position.
- Ferdinand Eberstadt, New York, an industrial banker and one of the chief architects of the original 1946 Unification Act and the 1949 version of the act, supported the House measure.

## Burke Testimony

Adm. Burke testified on the importance of maintaining these separate services with secretaries in direct administrative line of command under the Secretary of Defense. He said:

"These are the departments where morale and pride of service will be built where the requirements peculiar to the different modes of warfare are understood—where the effectiveness of various weapon systems is built up to the maximum extent which they are capable of."

The subject, for determining whether a combatant function is "major" and should be subject to congressional vote if changed or abolished, Adm. Burke said, should be:

"Would it put the service in a position where it could not fulfill its mission? A reduction in large change in 'major' and should be subject to congressional vote if changed or abolished, Adm. Burke said, should be:

"Would it put the service in a position where it could not fulfill its mission? A reduction in large change in 'major' and should be subject to congressional vote if changed or abolished, Adm. Burke said, should be:

"Would it put the service in a position where it could not fulfill its mission? A reduction in large change in 'major' and should be subject to congressional vote if changed or abolished, Adm. Burke said, should be:



## Twin-Turbine Westminster Makes First Flight

First flight of Kaman's 14-man turbo-powered World War II-era helicopter has been completed successfully (above). First test powerplant consists of two 2,800-cu-in. Napier Diesel turbo engines geared to a common rotor shaft. Kaman was received when aircraft was tested in mid-air at Fort Rucker the initial ground tests (below). Helix, helicopter is designed with a strong load point so it can also serve as an aerial crane capable of lifting more than one ton over a 100-ft radius. Helix is being tested in heavy transport. Overall fuselage length is 76 ft. Engines, mounted side by side, drive a five-bladed main rotor which has a 72 ft diameter. World War II-era and Westminster has a 400-cu-

inches and a 275-cu-in. cooling system. First flight lasted 64 min., during which Westminster was flown at 100 ft, 1,000 ft and banked steeply, and in hovering attitude. Twelve days of ground tests preceded this flight. Westminster is largest helicopter project undertaken in private contract by British aircraft manufacturers, officials said. Aircraft is now being tested to Sikorsky 5-61 (AW page 2, p. 27). Helix is based on duplicate of Sikorsky 5-55. Fuselage length is 35 ft. long, 18 ft. wide and 5 ft. 6 in. high. Cabin volume is 2,700 cu. ft.; typical military load would be 41 fully equipped soldiers or 31 stretchers each. Airframe refers to Ana Model. Maximum gross weight is 14,000 lb.





modified Tu-104 jet transport are used for flight of Moscow's Vostok airport; many heavy trucks in tax vehicles, modern passenger ramps. In background are E-125 C-130s, especially modified for construction cargo-passenger area both cargo doors open on main runway.

## Aeroflot Moves Toward Newer Ground Devices



Passenger dressed from Tu-104 of Aeroflot Aeroflot during light run. Loading ramp may be hydraulic powered. Staircase wheel at left indicates it is self-propelled. Baggage trailer Tu-104 uses a flat surface gear. This is one of first photos of Tu-104 with Greek markings.

E-125 Moscow, with turboprop engines attached, is in background. Baggage trailer on Tu-104. Note use of hold in full section of Tu-104 in left row. Vertical front loading platform also is one of the aircraft's forward loading doors.



Aeroflot command and dispatching center is dropped in background, but double-panel windows, possible to see main level from flight line. Equipment includes VHF-UHF receiver and electronic light display (left), air traffic control operator (center) and radar operator (right) seated before head sets. One-time radio. Market radio at left right may be ground-to-aircraft approach. Russian air forces to be working on CCA.



New facilities with Aeroflot markings is steep contrast to existing and truck under way.

Another Navy Vanguard attempt to place 10th satellite into orbit proved unsuccessful but took when the second stage failed to ignite. Launching from Cape Canaveral had been delayed several days because of electrical troubles attributed to excessive humidity. Another launching schedule, to be tested shortly, will be fitted with a satellite carrying a different set of instruments.

British test air sea has been eight aircraft failures of Sea Venom intercept fighters from crashes following a fatal in-flight accident from E-125 Air Force. Admiralty and investigation has reached advanced stage and that it is hoped to clear the accident completely.

Duncan McLaughlin, Inc., Danbury, Conn., will furnish its approach landing and takeoff simulator to Aeroflot's Moscow-based under \$1.5 million contract. Simulators will be used in studies of airport lights and markings and human reactions to them. AMB will

Aeroflot's Radio Inc. (Aerof) has transferred its 120-man radio-telegraph group to newly created sub-entity, called Aeroflot Research Corp., following a division several months ago to make the group's services available to defense and/or non-defense groups. Aeroflot's research group had been created to advise and Defense Department program John S. Auer and. Aeroflot president, levels the new sub-entity, G. R. Wright, former director of the research group, becomes research director of the new corporation.

Radar radio network designed to detect and track aircraft, whether or not they emit radio signals, will be constructed from coastlines U.S. by Naval Research Laboratory which will construct specific Mintrack stations at East and West Coast, agencies of a reconnaissance-type. Design contract in Texas is assigned to Aero S. Ballistic Research Laboratories, Aberdeen, Md. Data collection and analysis will be handled locally. In Vanguard Contracting Center in Washington and by an Aeroflot center at Dnepropetrovsk. AMB's existing program.

Locking Devices, Aero Manufacturing Corp., announced Air Force-issued contract for production versions of the T-13 L-1 turboprop are expected to total about \$6 million. This is first production contract for a small U.S. turboprop. Locking test Contract specifies delivery beginning in November. Locking has served Air Material Command contract for \$1.5 million.

# Military-Airline Doppler Dispute Grows

Defense Department meeting sought in an attempt to settle dispute over Doppler frequency allocations.

By Philip J. Klein

Washington—Airlines that seek more frequency allocations are being asked to meet with the Defense Department to discuss their needs, according to a spokesman for the Department of Defense. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

request to buy, until it can Doppler which operate at a frequency that "floats" by existing allocations.

The airline petition also points out that FCC has not set out rules for the 35,000 mc band for civil Doppler use and that it may take six months or more before such rules are likely to be issued. It also states that there are no other bands for other civil Doppler users. Radar Doppler can operate at 13,000 mc, which is well within

## Interference

The recent FCC order, which stated that the military, not civil Doppler, "can be authorized temporarily until needed," for operation at 5,500 mc band has "not meant any less full satisfaction that will be experienced" from defense users.

Although Air Force is sponsoring development of a Doppler system, operational at 13,000 mc, it is not using and having Doppler used in production quantities that operate at 5,500 mc. This suggests that USAP is not too far from developing a system that can be used in production quantities that operate at 5,500 mc.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.

The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations. The meeting is being held in an attempt to settle a dispute over Doppler frequency allocations.



## Long-Range Version of Tu-114 Introduced

Recent test flights at Kirov's Tu-114 transport indicate that the aircraft has a maximum range of over 6,000 miles and could easily be the 4,000-mile version from Moscow to New York country. Soviet officials say the long-range version of the Tu-114 covers the 5,700 miles between Moscow to Kirov "with still not sufficient fuel remaining in its tanks by its scheduled 13,800,200 kilometers (8,581,242 miles). Tu-114D freight is shorter than that of the double deck Tu-114. Wing also appears to be set long.

established. There a five-year program needs to be passed. If just procedure is followed by Doppler, instead, it could be expected that a five-year program would be passed. An FCC representative declined to speculate whether the new system would be used in production quantities that operate at 5,500 mc.

If airlines find it necessary to raise to federal courts over legality of the commission's action, a number of other users may come up, especially FCC. This includes:

• FCC's past record of largely avoiding to make spectrum requests made by Defense Department since the question has concerned it only in a limited way by Congress, been indirectly passed over to the Executive branch where frequency allocations affecting civil users are made under security laws.

• Civil air service installations rely upon FCC frequency allocations, even those established by international treaties, when striving to develop new equipment. It is difficult to normal commercial rules, since the manufacturer also has the possibility that by the time equipment is developed for use in a specific band, that frequency will have been withdrawn from civil use without public hearing.

• The Board's decision that Slick indicated a desire to continue scheduled air freight service which, possible and then it was in the public interest to grant the temporary suspension if the carrier is unable to do so, steps to terminate its certificate could be taken later, the order said.

Slick's temporary suspension authority was viewed by the Board as an aid to Slick's operations in its operations "in keeping the nucleus of its operations intact." In granting operations by independent Airlines Airmail that the cargo aircraft during the year ending June 30, 1957, and an estimated \$17,000,000 per

the first month of this year. The CAB order noted that the carrier actually suspended operations two days prior to filing a formal request for suspension. It added:

"Obviously, an attempt to suspend the carrier to resume and continue scheduled service in the face of these outstanding loans would adversely affect it to bankruptcy and would destroy any chance of an ultimate resumption of service."

The request was granted subject to conditions that Slick must file the bond on or before the termination date of January 1959, or give plans to resume operations and that scheduled service will be resumed by 1957 CAB order.

Slick's application brought a sharp reaction of protest from American Airlines, the City of Philadelphia, International Air of Manhattan and the Independent Airlines Assn. The complaints included requests that the application be set for a hearing, that it be denied and Slick's certificate terminated, that if temporary suspension were granted it not be made renewable at Slick's option, that the carrier's entry certificate be withdrawn and that the bond which is not in compliance with the conditions for the protection of Slick's employees.

The Board's decision that Slick indicated a desire to continue scheduled air freight service which, possible and then it was in the public interest to grant the temporary suspension if the carrier is unable to do so, steps to terminate its certificate could be taken later, the order said.

## CAB Gives Approval To Slick Suspension

Washington—Slick Airlines Inc. last week won Civil Aeronautics Board approval for a temporary suspension of its cargo air service as a result of combining its 5-employee divisions.

One of the first all-cargo carriers to request authority, Slick last month lost \$5 million during the year ending June 30, 1957, and an estimated \$17,000,000 per

year and such losses are "preliminary" IAAI demands for a protective order should now be denied in that grounds that it would "place itself before licensed data on Slick," and leaves the carrier's hopes of negotiating regular services.

## Congress Approves Record CAA Budget

Washington—Congress has approved a record \$421 million fiscal 1958 budget for CAA—\$74 million over the fiscal 1957 allocation.

Meanwhile, House Appropriations Committee passed favorably last week a bill for an additional \$66.2 million for '58. New Washington agency, \$15 million. The project was bracketed this year with a \$12 million appropriation. • Defense and regulation, \$17.5 million. This is for construction and testing of traffic controllers, maintenance technicians and other personnel to assure that newly installed air traffic control and navigation facilities will be placed in service as soon as possible. • Congress also approved 1958 budgets for:

• Aeronautics Administration, \$31.5 million. This is short of the \$34.3 million requested.

• Civil Aeronautics Board, 16 million, \$200,000 over fiscal 1958 total.

• Aeronautics Administration, \$47 million. This compares with \$35.2 million this year.

The only major cut made by Congress in CAA's requested budget was \$16.5 million for language study. It was provided that these facilities should be financed by the Defense Department budget. Key items in the CAA budget include:

• Operations and regulation, \$230 million. A \$40 million increase.

• Establishment of air navigation facilities, \$118 million.





# ACC Approves Weather System Plan

By Robert H. Cook

Washington—A Coordinating Committee has approved adoption of a new national aviation weather system as part of the Federal Aviation System of an estimated cost of \$700 million.

Subscribed by the Weather Bureau after a one-year study, the plan is designed to meet the needs of the Civil Aeronautics Administration for more accurate and timely weather information provided by the growth of air traffic.

Although Bureau officials have not yet released an actual cost estimate, observers say the plan's heavy concentration on long-range radar, automatic equipment and the expansion of ground facilities over a five-year period from 1959 to 1964, would cost \$30 million for the hardware system.

The plan calls for lengthening open receiving and expanding terminal air receiver service and extending present weather information to 40,000 ft to help ensure safety positions found by accident or accident compliance rules and high-visibility flight operations. Other phases call for expansion of the existing weather system, support of a research and development program to keep pace with aviation growth and a future high-speed communication system.

In detail the plan would provide:  
• **Terminal weather.** A total of 100 remote measurement of weather elements directly in the airport approach area for landing and takeoff under

low weather conditions would be part of installation of existing lower and center and transmitter to measure variables such as middle marker of each ILS system and low-level point separately. Measurements would allow a continuous measurement of approach light contact height and remove variables for the pilot. Units are now installed at 12 locations with Weather Bureau plans calling for a total of 225 by 1964. Instruments will initially be completed monthly pending a more fully automatic operation.

A fully automated service also will include automatic weather observing and high-power stations using scanning elements to report temperature, dew point and wind speed/pressure readings. Transmitted data will be automatically recorded on punched tape.

• **Terminal altimetry.** The final approach and landing, the critical will indicate trends and fluctuations in the approach light contact height and range visual range within the final 100 ft of 5 to 15 mi. This, officials expect, is of primary importance to pilots, terminal air traffic control and other users of desired airport approach routes.

The landings and traffic control progress, forecasts will cover in detail weather conditions in the approach route area for periods of one to two hours in advance. They will include cloud height of the middle marker, visibility at the touchdown area, wind

direction-speed and any hazardous weather conditions.

• **High-altitude forecasting.** Seven high altitude forecasting centers will provide information for planning of flights between 20,000 ft and 40,000 ft over the U. S. and adjacent waters over Asia, Europe and South America. These centers will be fed real electronic digital computer output with completed wind and temperature forecasts of potential weather information will be substituted by high-power forecasts for prevention of equipment is expected to make upper air observations at 100,000 ft level 7 times a year.

• **High power weather Bureau.** Experts expect expansion of its radar weather tracking stations to cover the areas by 1964. WSR-77 Radar detection radar with a 100 mi range are to be installed in Miami by September. Total radar coverage system will utilize 100 sets requiring a crew of five men at each installation. Six new radar will also be installed by mid-1959. The Weather Bureau is presently using converted World War II radar sets.

• **Information dissemination.** Wholesale distribution of weather information is planned by use of existing terrestrial radio channels, automatic traffic receiving system, existing connections to the nation's weather telecommunication system and special audio, closed circuit television. The present microwave aviation weather broadcast, made in cooperation with the Civil Aeronautics Administration, will be extended to all existing long-horizon radio facilities. Television will be used at selected international airports for the landing of international flights.

• **Weather stations.** Airport weather stations will be established at 25 high density airports. Reports from remote areas will be provided by placing light meter stations on mountain top locations where atmospheric conditions cause intense absorption errors. All weather stations which have been found to reduce personnel, and thus their hours of operation, will be required to a 24 hr service.

• **Research and development.** Establishment of a dense grid of specially instrumented automatic weather observing stations about a major airport to provide maximum data will be an important phase of the system.

A similar network of stations, 30 mi apart, has been under study in the Texas, California and Kansas area for area three studies. Experiments will be conducted in testing the data into a central computing system.

Further studies will be conducted at the seasonal pattern of the jet stream and their effect.

Development work under way to produce the basic upper air and low power forecast by electronic computer will be intensified.

## SHORTLINES

• **British Overseas Airways Corp.** reports a 28.4% increase in cargo traffic on its routes between the U. S. and Britain for the fiscal year ending March 31. BOAC's transatlantic annual cargo total of 7,759,000 lb of cargo in fiscal 1957-58 as compared with 2,445,361 lb in fiscal 1956-57. Westbound flights showed a 40% increase of 3,418,550 lb as compared with 2,445,361 lb in 1956-57. Eastbound freight was 1,517,649 lb as compared to 1,270,744 lb the previous year.

• **Capital Airlines** says it will be using Vickers Viscounts on about 50% of its flights between terminals. The airline also said it will adopt certain schedules to meet the seasonal decline in business travel during the peak season. Consultants will be hired to study new routes. **Continental** (AVL Jan. 25, p. 54) beginning tomorrow, all Capital flights will operate in and out of New York, from Los Angeles and Newark to reach the east.

• **Delta Air Lines** reports its April cargo handled by its 445 new April and July at 1,000,000 cargo in tons. The airline attributed the gain to a contracted sales effort and the introduction of a new fleet of D-46s, Delta's modification of the Convair C-46.

• **Douglas Aircraft Co.** is planning to increase utilization of its DC-3 to help in maintaining inventories of spare parts in New York and Europe. By installing a brand range of engines at New York's International Airport the company expects to be able to provide emergency replacements to airlines on the Eastern seaboard and in Europe from their New York office. Other spare parts, maintenance too large to be completed from New York as conventional passenger transports will also be maintained at a central point in Europe.

• **United Air Lines** reports it opened 10,241,000 revenue passenger miles in June 15 to set a company record for single-day passenger traffic. The record performance is attributed to post-peak travel and the start of the summer vacation season.

## AIRLINE OBSERVER

• **Quaker Airways** moved to ease international traffic between ports within the U. S. (AW May 19, p. 55) will be reviewed by the Civil Aeronautics Board in public proceedings. In its original petition, Quaker asked for a set of Board to inspect the "abandonment procedure" of the Civil Aeronautics Act of 1938. The carrier seeks a ruling that would permit it to file an application with the U. S. post and discharge it at another U. S. port if such traffic is not received. In the public hearing on the proceedings, the Board desired an American Airlines motion to dismiss the case and a United Air Lines motion to withdraw. The Board attached a referendum system in the order to get interested parties an opportunity to express their views before July 7.

• **Comprehensive survey of passenger reaction to the new color control plan** has been ordered by the Board of Director of the Air Transport Association. To be conducted by a private organization, will be terminated prior to the November meeting of the Air Traffic Conference when airlines will open talks on the future of the plan.

• **Eastern Air Lines** is showing strong interest in the Boeing B-27 turbo-prop transport as a replacement for its large fleet of DC-3 and is discussing a total purchase of 60 units of this, as at least partially manufactured and assembled in Brazil. Tuller operates a small plant in Rio de Janeiro producing light transport planes for the Brazilian Air Force. Tuller will expand the plant and manufacture B-27s in Brazil if development justifies the move.

• **Kaiser's twin engine An-14 Pebeles (Little Bee)** short-haul transport has successfully completed tests on 100 test flights. Recent altitude tests showed that the aircraft's top ceiling is between 36,000 ft. and 17,000 ft.

• **Watch for a move to extend one aspect** at Washington National Airport to 5,000 ft to accommodate intermediate range jet transports. Rawson will be expanded southward by using fill as the Potomac River. Proposal however has been presented to the Bureau of the Budget. Plans for the second Washington airport at Chantilly, Va., include two parallel runways 14,500 ft. as length and a third cross runway of 10,000 ft.

• **Capital Airlines** will establish an electronics research and development group within its finance department to keep the company abreast of advances in data processing equipment. Of special interest to the airline is electronic application to its integrated flight system.

• **Military services** will wage concerted campaign against implications that military aircraft are at fault in accidents involving "low cost" airlines. A new point of contention between representatives of Capital Airlines and Air National Guard during hearings on the Beechcraft MD-46, includes claims which open areas in Washington.

• **Civil Aeronautics Board** staff is scheduled shortly to recommend appeal to the Supreme Court of a decision by a Court of Appeals that the Board has no authority to require disposition accounting procedure of the airline. If the Board decides to appeal, it first must request assistance from the Solicitor General to file a petition with the Supreme Court. The Board has 90 days in which to take such action. Original Board ruling on disposition which became effective Jan. 1 was upheld by a U. S. District Court as the result of a suit filed by 40 airlines. With the removal of the lower court's decision, airlines now can classify equipment as fixed assets and that apply depreciation without appeal to the Board. Under the Board ruling, such equipment was categorized as current assets and could not be depreciated without special appeal.

• **Civil Aeronautics Administration** has announced the purchase of 15 aircraft to replace used war-time Twin Otter biplanes, but at a cost of \$19 million. The equipment, designated AS-7s will have 4000 cc engine up to 27,000 ft and will be equipped with oxygen production and cooling target indicators.



**F-27 Delivered to West Coast Airlines**

Boeing F-27 turboprop transport aircraft are delivered to West Coast Airlines June 22 at company's Bismarck, Md., plant. West Coast has ordered six F-27s for routes which cover 44 communities in Pacific Northwest. First passenger service is provided by Roll-Iner D-8 engines (AVL April 22, p. 57) producing 1,733 hp. Aircraft also can be equipped with Roll-Iner D-7 engines, rated at 1,999 hp. Also, Civil Air Institute (CAI) will be second to buy a number of line of aircraft flying on former model. Latest order is order F-27s to West Coast Airlines & A. (Boeing) which has ordered three and six options on two others.





### "SAC" ... the mailed fist and the velvet glove

The greatest factor in keeping the cold war cold is our Strategic Air Command. This group of men has the supreme responsibility of preserving the peace of the world and its harshest night is our best defense. The spirit of corps of these dedicated men has been whittled to a man's edge and nowhere on earth is there a finer example of teamwork. Evidence of this teamwork is the Kaman crash rescue helicopter — a velvet glove to stand on the alert with SAC's mailed fist.

**THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONNECTICUT**  
 PIONEERS IN TURBINE POWERED HELICOPTERS

## SPACE TECHNOLOGY

### Environment Burdens Satellite Control

**Radio-herald** control system for maintaining the attitude of a very sensitive satellite, and a host of the more difficult problems associated with its design, were outlined here by Dr. R. E. Roberson, chief scientist of control engineering, North American's Astrodynamics Division. Roberson's paper was presented at the summer general meeting of the American Institute of Electrical Engineers.

At first glance, controlling the attitude of a satellite vehicle appears simple, Roberson said. Vehicle behavior as if it were suspended in a forceless prot, so only small control torques are required. There usually is no need for extremely precise measurement and adequate computer means are "indirectly low" by conventional zero standards, Roberson said.

The crucial distinction of the problem is that it is to be "solved at the instant control problems you can imagine," Roberson warned. "A whole set of special problems arises in the hardware to play the control system designer, even before he gets to the hardware stage. And then, of course, he is confronted with all the physical constraints and environmental problems unique to space equipment."

#### Major Problems

Dr. Roberson (AW April 23, p. 71) listed the following major problem areas in the development of attitude control systems.

• **Reference frame selection**—Unlike terrestrial vehicles where gravity (and control) provides a natural reference, there is no convenient frame of attitude reference unless the satellite is stationary. If attitude control is achieved in the earth, then frequent corrections (swobbling) in vehicle attitude will be required because of ellipticity and eccentricity in satellite orbit. On the other hand, if the satellite attitude is continuously controlled as if the vehicle were moving around the earth in a perfectly circular orbit, a non-spherical vehicle will be subjected to disturbing torques because gravity and centrifugal force are not acting through its center of gravity. Either frame of reference sets up perturbations which complicate the attitude control problem.

• **Analysis of torques**—Compared with terrestrial vehicles, a satellite will encounter small extremely small torques, but it does not require much to disturb a satellite because of the absence of steady-state damping. Space vehicle

designers must therefore determine the source and nature of all external torques (those moving masses within vehicle) as well as external torques from such things as the earth's magnetic field and intra-orbitic impact, then calculate their effect on satellite attitude. Torques produced by the twisting of an elastic member or the operation of a relay structure, which can be completely ignored in terrestrial vehicles, but be considered in a satellite.

• **Equation of motion**—First, of developing a complete set of dynamical equations for vehicle motion is far more difficult than might be expected, Roberson said. These equations coupling between roll, pitch and yaw and con-

straints which complicate the problem.

• **Orientation sensors**—Development of devices for measuring satellite orientation relative to selected frame of reference which are sufficiently accurate, reliable and consume low power is a challenge. In some instances where the vehicle has inherent stability, it may suffice to merely measure rate-of-change of satellite attitude.

• **Torque applications**—Variety of techniques can be used to apply corrective torques for maintaining vehicle attitude. Most useful, Roberson believes, will be those which use inertial reaction of matter expelled from a satellite as matter which is moved about within



#### Thor Nose Cone Afterbody

Afterbody of Thor ICBM nose cone is pushed into its core case at General Electric Co.'s Philadelphia plant. Thor nose cone (AW May 5, p. 39) is mated to lower part of the core

# BOMBS AWAY...

with the help of heat-treated  
**TITANIUM ALLOY**

On high speed military planes, such as the Douglas A1D 2 Skywarrior and other jet aircraft, the bomb system rack is a complicated and critical mechanism. Any failure might endanger both airplane and pilot.

These base parts make up the reactor cylinder, piston and launch. The latter presented the greatest design problem, due to its combination of function and irregular shape. Similar launchers made from stainless steel frequently heat-checked and failed, during test firing or hydrostatic testing.

Experience and design calculations suggested that 6Al-4V titanium alloy, produced by Mallory Sharon, was the metal most likely to meet the existing requirements.

Actual firing tests confirmed the advantages of titanium for this application.

#### WHY TITANIUM WAS CHOSEN

1. High strength to weight ratio at elevated temperatures (to 600° F)
2. Superior corrosion resistance qualities.
3. Excellent longevity.
4. Good machinability in the heat treated condition.
5. Low susceptibility to hydrogen embrittlement.
6. Good thermal stability.

The titanium alloy launch withstood 300 firings before any evidence of heat-etching appeared. No failures occurred in firing, and the launch withstood hydrostatic pressure of 22,000 psi without failure.

Here's one more example of titanium's outstanding performance in meeting critical design problems. May we help you explore its advantages for your product or application? Write for "Titanium Fact File."

**MALLORY  SHARON**

MALLORY-SHARON METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals



Above: Bomb system rack showing large titanium alloy launch (inset).  
Below: Titanium alloy reactor launch, before and after machining.



Thor Loaded in C-133A

Despite Thor intercontinental range ballistic missile is loaded in a Douglas C-133A Cargo aircraft. Assault is powered by four Pratt & Whitney T1473 turbo-prop engines of 6,000 hp each. Never seen at the cargo airplane, the C-133A will be powered by Pratt & Whitney T1458W engines. The C-133A is reported to carry more than 26 tons at an average speed of 120 mph for a distance of 4,800 mi., an increase of five tons over the original capacity of the C-131A. C-133As will carry KC-13As and SR-71s soon ready.

the vehicle. One promising approach is to employ variable-speed fans, but setting of a rate which can be related to an electric or other type of motor.

#### How Flywheel Work

When an attitude-control device detects that the satellite is starting to free float out of its target zone, its signal causes the motor to start to rotate the flywheel in the same direction as which the satellite is tending to turn. The problem here is the opposite direction applied to the satellite through the flywheel's supporting bearings.

Three such motor-driven flywheels might be used, one for each major axis of the satellite.

However, because of self-erroneous motion, a single wheel could serve both and eight axis provide improved transient response, Robertson says.

An extremely simple control system, intended to prevent oscillation of the satellite and about a small degree of attitude stabilization, might employ three rate gyroscopes.

Proposed attitude buses were introduced to use, with deeper systems used to jet control.

Signals from each gyro would be fed to a corresponding auto-driven flywheel. Voltage applied to the motor would be roughly proportional to rate at which satellite is starting to rotate.

Some type of integral control might be employed to prevent accumulation of small permanent errors in vehicle attitude.

Using the booster and its own engine thrust, the F-108D took off from its launcher with gun, fins and leading edge flap extended (AW June 2, p. 27).

The fighter accelerated to a speed of 275 mph in less than four seconds.

The new launch technique is significant because it gives the operations of the F-108D, and possibly other aircraft, more flexibility than they have when they must use conventional runways. North American has been studying production models of the F-108D to handle zero launch.

For a zero launch, the F-108D is jacked into position on a mobile trailer. After the fighter bomber has been positioned at the correct angle on the launcher, the booster is attached. The jet engine is started, the afterburner is set on, and the pilot flies the booster with a trigger. Airframe and pilot are safely jettisoned before the booster burns out. Astrodyne XMS-24 booster was tested for zero launch under an Air Force contract that started work in 1957 when the plant was run by the Rocket Fuel Division of Phillips Petroleum Co.

Astrodyne is a new company jointly owned by Phillips and North American Aviation.

An important factor in the new launch is the necessity of firing the air craft at exactly the right angle to it won't loop or dive into the ground. This requires a very precise gas turbine of the line of thrust in the atmosphere's static booster.

## Astrodyne Rocket Launches F108D

Edwards AFB—Zero launch of a North American F-108D was made with an Astrodyne solid propellant booster rocket developed 150,000 lb. of thrust.



## Lightweight Launcher Designed for Locrace

Lightweight launcher, designed to provide helicopter transportability for Army's Locrace subsonic surface guided missile system, was developed by Cornell Aeronautical Laboratory.

## Swiss Build Mobile Anti-Aircraft Missile

By David A. Andrus

Zemach-Ten battery of the Contraves Oerlikon RSD 55 anti-aircraft missile is completing acceptance tests for the Japanese and will be delivered next.

A single battery has been ordered for trials which could result in increased production of the weapon in Japan. In addition, there has been much positive interest shown by other countries.

The missile system has been designed for complete mobility using only standard military tracks. It is a point-to-point weapon, built around a 20 ft long liquid-propellant rocket motor. Guidance is beam riding type. Effective shot range is about 14 mi, and launch rate speed of the missile is Mach 3.4.

Earlier development of the RSD 55 and its associated launching rocket was aid in part by General Electric AG, and its parent firm, Westinghouse Electric, Oerlikon, Bellini & Co. Progress began shortly after the end of World War II, and has been continued through two basic missile designs to the present configuration.

Contraves was originally the electronic division of Oerlikon, the missile program originated there. In 1957 the responsibility for both complete missile development was transferred to Contraves, by then a separate firm. A hospital—speaking competency—all lights, computer equipment and technicians have served the program through a focus on beginning about 12 years ago to its current state.

### Nature of the Threat

The Swiss missile system possesses an entire attack by jet-propelled aircraft operating at a high subsonic speed and maneuver to high altitude. This requirement was fundamental at the start of the missile program in a theater of the then-current threat was highly maneuverable, low-altitude. Concept of a single battery is a mine with a peak altitude of about 60,000 ft. A good average shot range for the system is about 10 mi, comparable to the performance of the U. S. Army's Nike Ajax.

Maximum effective range is based to derive and vary with the conditions of the attack. Contraves quotes a maximum range between 8,300 ft and 16,400 ft shot range. Such numbers can be criticized for some tactical situations where the threat is a low-level attack.

But one Swiss engineer pointed out that the maximum range has been set to meet that "worse or later they've got to go up high to get out the hills."



**TARGET TRACKING RADAR** (left) is a three-axis unit developed by Erlangen firm MELLE. Aperture at right of dish is for conventional reference sensors used to check automatic tracking, or for manual tracking. Beam-riding tube (right) in the foreground can, with both coarse and fine focus beam control systems. Coarse focused sections rotate coarse focus, dish and beam tube transmit the fine focus. Aperture is shown for the data collection in mobile flight path.



If they come low down into the valleys, we believe the best defense is still either anti-aircraft cannon with a high rate of fire." Operation of the present attack phase of the system was would probably agree.

The missile system possesses the endurance of an anti-aircraft system, to which the missile defense are tied by requirements. Given these conditions, an anti-aircraft rocket system can be moved into the field for point defense of a specific target area.

A typical division consists of three missile batteries and a control command unit, which can be sited up to about 20 mi from the batteries.

### Mobile Appeal

The battery itself is a mobile unit, designed for field use from transportable sites. The appeal of a temporary site is very great in the land-poor countries of Europe which cannot afford to maintain large expanses of valuable land used to raise kind of a fixed military installation.

Lightest single piece of equipment weighs about 12,000 lb, and no single unit is larger than a conventional radar tower. That the battery is so transportable, although it was not a design requirement. All pieces can be moved by standard military wheeled vehicles or by tanked point carriers if they are available. Even pigs will do the job. The vehicle has been to get a mobile system independent of special vehicles for mobility and able to hitch a ride on practically anything with wheels.

There's been much cooperation a stand-



**MOBILE RADAR** target acquisition radar is key portion of equipment of division level, covers the three missile batteries of the division. Laboratory comes from early writing order set in the unit, a three piece along to proper missile battery.

### Basic Data—Contraves-Oerlikon Missile

Model designation	RSD 55	RSD 57
Type	Service	Training
Length, ft	18.7	18.7
Max. diameter, in.	68.5	65.5
Tailfin length, in.	500	615
Raising height, ft.	45	30
Thrust, lb	2,200	2,200
Velocity at launch, Mach	2.8	1.8
Altitude of launch, ft.	40,000	78,700
Effective vertical altitude, ft.	65,700	48,250
Shot range, mi.	38.7	
Maximum useful range ft.	8,200-16,400	



**TWIN LAUNCHER** holds pair of Contraves-Oerlikon RSD 55 missiles ready for launch. Members are loaded from tracks seen leading from platform of launcher, small dollies serve as transport and loading devices. Launcher wings around and push up missile from dolly, arrange in proper loading and elevation on signals from control center. Loading cycle takes one minute.

THE DUNHOV 100

THE DUNHOV 100

THE DUNHOV 100 METROPOLITAN

and now...



## the Canadair 540 Airliner

BUILT BY CANADAIR LIMITED  
SUBSIDIARY OF GENERAL DYNAMIC CORP.

and powered by NAPIER ELAND  
3,500 e.h.p. TURBO-PROP Engines

ORDERED FOR THE R.O.A.F. TRANSPORT COMMAND

Based on the well-proven design of the Canair 440 but with the improved performance and economy offered by turbo-prop engines, the Canair 540 has an increased range among medium and short haul operations all the world over.

**NAPIER Eland turbo-prop**

NAPIER ENGINES INC.

105 Regent Street Building, Wellington N.Z. Tel. North 7-1000  
Subsidiary of G.P. Overy & Son Limited, London, England

A Member of The ENGLISH ELECTRIC Aviation Group

and battery a constant station, a target-tracking radar, the beam guidance radar, six two-axis searchers and four three-axis searchers. Missile assembly, checkout, and release functions of a logistic console are mutually separated from battery-level operations.

Set-up time for a single battery, from the time it arrives in the field until it is ready to accept targets, averages a half-hour. Yet some technical officers believe that time could be reduced substantially as an engine becomes familiar with the unit.

### Division and Battery

Key parts of equipment at the division level is the target acquisition radar and its associated guidance equipment. This radar was developed and is built by an Italian firm, Macchiellabbe Società per Studi di Applicazioni di Elettronica S.p.A. Effective operating range of the unit is between 91 and 124 mi., at something like 18-25 mms (light) time of modern speeds.

The radar gets its aerial information from the main searcher set, receiving knowledge of a threat and its approximate bearing. It assigns the set, so receives the target and locks on.

In the main bearing, the division commander uses one two Model A11 301 PPI presentation scope, made by Alkermat, A.G. Zurich, which shows target bearing and a transparent plastic plotting board which is hand-manipulated by a visual monitor at the control station. The division commander chooses the battery which will handle the particular target now in the screen, and sets them into target tracking radar system. Target data is fed to the battery target-tracking radar, and once the latter unit has locked on, the vision's target acquisition radar is fine-tuned to the last set of data from the main-bearing set.

Combat action is now outside the choice of the battery commander.

Target tracking radar for the battery is a Belgium development built by Messerschmitt-Bölkow-Loebbe of Brussels (MBL) S.A. (MBL). It is a movable turret three-axis, its servo-control system and its carriage were developed by Calspan.

Slighting through an aperture in the radar dish is an azimuth reference camera. This is used by one of the two-axis operating, the radar is a visual check on who is being tracked. Normal tracking is automatic after the lock-up, but manual tracking can be used if necessary. In this latter situation, the reference camera is a big help.

Data from the target-tracking radar goes to the beam-gyroscopic radar and to the searchers, which compare it to terminate the tracking overhead and signal the proper direction to the



DIVISION COMMAND POST has visual presentation of situation on two PPI scopes and plastic plotting board for continuous reference in the tactical situation.

equipment. The beam-gyroscopic radar is also a three-axis system, with main and fine beam searchers arranged in a single dish, and a camera gas used through an aperture in the dish for tracking. Beam-gyroscopic radar equipment was developed by the firm Via di Brera Brown & Co. servo-controls and linkage were again the work of Centro Control.

With the target-tracker locked on the beam-gyroscopic radar oriented and aimed, and the searcher searchers pointing in the general direction of the target, the battery commander gets a series of green lights which signal battery readiness. He fires a specific battery with push-button switch.

### Flight Performance

The missile blasts off, drives only by its 2,200-lb. thrust liquid rocket motor; no booster is used. Initial thrust-angle rate is about 2.5 for the take-off weight of 515 lb. Burnout time is about 47 sec, and at that point the missile has worked about Mach 2.4.

Control of the flight path comes from the beam-guidance system. The missile is launched into the capture area of the wide beam and, after being directed into the center, is switched automatically to the narrow beam, which causes it to hold the search unit steady or fine-tune it. The fine can be set off either by command from the ground or by passively to target.

Control forces are generated by regular displacement of the rocket jet exhaust, the motor shaft is gimbal-mounted on a double gimbal. In addition, four cushion control surfaces are fed into the strap, one pair to each ring, so that corresponding control surface deflections are produced when the motor is revolved. The smoothness reduces work during the burning period, and are the only control remaining after burnout. At that time, there

deflection occurs substantially to compensate for the sides loss in crucial moment from the rocket engine.

During the burning cycle, the center of gravity is moving as the warhead penetrates deeper the atmosphere, axis close of fuel and oxidizer. With empty tanks, the static center of gravity must be well forward of its position where the tanks are full. This would effectively increase the stability of the missile, and make it consequently stable in response to control signals, just when it was closing on the target and needed maximum maneuverability.

Control in guidance role of the one is making the entire wing assembly movable. After burnout the four-disk nose air mass formed by individual piston pushing, on an external ring structure which can swing together, and is aimed on a solid rail on the outer wall of the track assembly.

### Firing Sequence

The use of two-axis searchers probably indicates that a pair of weapons are fired against a single target with a few seconds time lapse between firings. If the first round hits, the second could be directed to another target as the immediate vicinity, although in practice this would probably take a skilled operator. Still probability of the missile is not negligible.

Contractors use a loading cycle for the launcher inlet one minute, this means that a given launcher can get off two rounds per minute, or that all six launchers firing at once actually can get 12 rounds into the air during one minute. Whether or not the radar system would be saturated by such a high cycle rate depends somewhat on the target area. If the density were inadequate enough to attack in five waves, the down rounds in the air could be brought to bear one at a time on the lost ship of the formation, and in it

BUCKETS  
and  
BLADES

tooled by

THEM

means

RELIABILITY

The tools we design and produce are used by companies that forge, cast, mill, machine and grind in all configurations. Your inquiry is invited. . . our field engineers are at your service.

INTERNATIONAL METERS CO. INC.

MAIN OFFICE & FACTORY  
IRVING, NEW YORK

CHICAGO • LOS ANGELES • NEW YORK  
PHILADELPHIA • ST. LOUIS

was knocked off, the beam could shift only slightly and orient on the next as fast.

But as a target in a long pugle would be a difficult target to track and would probably require the attention of more than one battery.

#### Airframe Details

Contractor supplies the two beam buses of the cruise Type ASD-58, a seven weapon with an 88-lb. warhead, and Type ISC 57, a training missile in which the warhead is replaced by practice chutes for recovery of the beam set round. Physical appearance of the two types is identical, but performance varies considerably.

Launch of the Contractor weapon is conventional, with an optical nose see-

ing, cylindrical body and heat-treated base. Lift comes from four delta wings with tips slightly upturned, control is handled by a set of four small three-control fins angled at 45 deg. to the planes of the wings, and by a gas-lifted rocket motor.

Structure is unconventional as major stress. The fuselage body shell around the tanks is made from hollow aluminum tubing about one-eighth of an inch outside diameter. The tubing is wound on a mandrel to give the shell an overall shape, and the ends between the adjacent tubes are filled up with Araldite, an epoxy resin manufactured by the British firm of Ciba. The resin is cured in place and the resulting shell is strong and lightweight.

Beaming begins as the shell air starts

by a series of longitudinal struts made of aluminum alloy, cross-section shape resembles four small "bar"-section struts joined at their bases.

Wings are sandwich construction, with each skin made up in turn of a lightweight rectangular grid of aluminum alloy with Araldite bottom and top skins.

Each delta panel weighs about 4.6 lb., and can take an air load as high as 4,000 lb. corresponding to about a 10G load.

Control surfaces are magnesium alloy. Magnesium and aluminum alloys are used for the majority of the structure.

The missile breaks down into four major components:

- Nose section, containing the acoustic equipment of the guidance system, the fuel cell warhead in the weapon version, and the parachute for nose recovery in the training model.
- Tank section, which extends from the base of the nose to just behind the trailing edge of the wing. This section contains a parachute plus fuelage in the training model, or just fuelage in the military version.
- Control section, which contains the electro-hydraulic servo-control valves, hydraulic pressure, parachute servo-control, etc.
- Powerplant box, mounting the liquid rocket motor on double gimbals.

#### Powerplant Details

Rocket motor in the Contractor-Delco-Ives missile develops a thrust of 1,200 lb. Fuel is oxidized ammonia and the oxidizer is white fuming nitric acid. This propellant combination was developed at the start of the program and has served the user through three separate powerplant designs.

Ignition is started by injecting jets of hypoglycote liquid sodium and acetylene.

The rocket motor is pressure-fed from two concentric-annular tanks surrounding a central nitrogen cylinder in the body. The nitrogen in the pressure stage feeds all internal apertures of the motor. It forces oxidizer gases through the inner ammonia tank and the outer oxidizer tank, drives a turbopump to supply electrical power, drives the hydraulic system which acts the launcher and even releases the loads used to hold the nozzle in the launcher.

Rocket motor is completely built of stainless steel, with no brass alloy used anywhere. The support band has a single ring of holes providing alternate sites of fuel and oxidizer. Gas internal regenerative cooling is used, but there is no liquid or steam cooling on the thrust.

Motor development, a complete program in itself, has been done by the same few engineers who did the rest of the work. Their first design for the early



**BATTERY LAYOUT** of the Contractor-Delco-Ives missile is not developed by the same contractor for other applications (containing the first design) (bottom) with the latest version (left center). Most stages of the beam-wing missile is about 15 in. long. It is a maximum of 2.4 ft. in diameter. Maximum altitude capability is about 60,000 ft. Missile is about 20 ft. long, weighs about 500 lb. Covered accommodations at contractor delta wings and could be replaced several times, indeed 45 deg. to the planes of the wings. First layout had creases; repeated wings available for control. Contractor, in cooperation with an associated company in Italy, has produced missile test models in both stainless steel and aluminum. Weapons test are to be held on the Saturna proving ground.

JET DIVISION

ELECTRONICS DIVISION

PNEUMATICS DIVISION

WEST COAST DIVISION

ACCESSORIES DIVISION

# THOMPSON PRODUCTS, INC.

announces the new

# TAPCO GROUP

fully-integrated facilities for design,  
development and production of components,  
assemblies, sub-systems and systems

NEW Tapco Group offers integrated facilities for...

## STRUCTURES



## PROPULSION



## CONTROL SYSTEMS



## GROUND-SUPPORT EQUIPMENT



Missile envelopes, air frames, pressure vessels, and other structures for every purpose can be designed, prototyped, built and tested within the Tapco Group "Pilotrance", an unusual method of extruding steel tubing to produce structural parts with integral end features, has been developed by the Tapco Group.

Components and assemblies for main propulsion systems to operate on any liquid or solid propellant, and for auxiliary power units to provide electric, mechanical, pneumatic or hydraulic power are within the capabilities and experience of the Tapco Group. In addition, much experience with nuclear power has been built up by the Tapco Group.

Electronic devices, as well as hydraulic, pneumatic, and mechanical controls and sensors, are an important segment of the Tapco Group's activity. The men and the facilities to coordinate all units into a complete system are ready now to research and produce systems of all types and complexity.

The ground-support components for any project can be supplied in the complete services and facilities offered by the Tapco Group. These include ground-support control and guidance devices, shelters and other activating mechanisms, transporting devices, and all types of ground-support mechanisms and structures.



# TAPCO GROUP

subsidiary of BAZANTER, INC., Electronics, Powerplants and West Coast Division  
*Thompson Products, Inc.* CLEVELAND 11, OHIO



# Tapco's Experience

includes work in these fields...for these projects...

ELECTRONICS

NUCLEONICS

AIR-TRACKING SYSTEMS

AIRCRAFT AND MISSILE  
CONTROL DEVICES

FUEL SYSTEMS

OPERATIONS SEQUENCING

SECONDARY AND AUXILIARY  
POWER SYSTEMS

COMPUTER-DEVELOPED DESIGNS

METALLURGY AND FABRICATION  
OF UNUSUAL METALS

HEAT-TREATING FACILITIES

TERRIER

HUSTLER

BOMARC

THOR

BULL PUP

JUPITER C

NIKE-HERCULES

707

ATLAS

PERSHING

\$308 million in annual sales by Thompson Products, Inc., is proof of the financial responsibility and integrity of the Tapco Group to develop, produce, and deliver any project or part of a project entrusted to it.



## TAPCO GROUP

subsidiaries of Bethlehem, M. Franklin, Franklin and Red Steel Steels

Thompson Products, Inc., CLEVELAND, OH, 44102

made developed 1,510 lb of thrust. This was replaced by a 1,700 lb thrust motor to increase the launch speed and overall performance. First stages still based on the original boost develop about 2,000 lb thrust. Motor is about six inches in diameter. Contractors operate a year of solid motor test stands in the country, where all the engine tests and development testing are done.

Each development stand in the Contractor program had guidance systems built from conventional vacuum tubes that were built, tested and located the manufacturing of the missile. Now all guidance gear has been made with transistors.

One of the problems facing the motor engineers was the possibility that the strong ionosphere in the rocket engine would interfere with communication lines between motor and missile. Consequently the antennas originally based part of the wing tips, to insure there is as far as possible from the jet. But tests later showed that missile was in contact. Antennas of the latest version are flat lens type, fixed at the extreme base of the missile immediately adjacent to the rocket blast. No difficulties have been reported.

The present configuration is the product of 18 to 20 years of development much extensive testing and firing of experimental and production stands

on several stages. Wind tunnel tests were made at the Federal Aircraft Factory at Esslingen, Switzerland, and at the Federal Polytechnic Institute (ETH) in Zurich.

Live stands have been fired in Switzerland, although with reduced fuel load because of the limited range. First test also was fired in France at Suresnes, near Garges train, place in the Oberalp region and in the Grosses Wannerland. Twenty stands were brought and captured by the USMC at Helmsburg Air Development Center in 1955. A current firing program is being conducted in cooperation with the Italian Air Force at the test range on the island of Sardinia.



**COBRA** anti-tank guided missile package on soldier operates manual control box. Cobas are fitted with indigenous guidance system, control a shaped warhead over visual range.



## Cobra Enters Infantry Weapons Race

Zerach-Commen-Gerlinde. Cobas were of anti-tank missile is a new entry in the competition for conventional orders for small infantry weapons in Europe.

Cobas, like M40 SS 10 and the Vickers Type 90, is a wire controlled anti-tank, remote operating a shaped charge warhead over a visual contact range.

It is perhaps more sophisticated than either of its European competitors, because the manual control system has a simple computer to reduce over control, and the tracking-aim guidance system has a third wire for aiming the missile.

There are currently two variants of the Swiss-developed missile available as weapons Cobas I, sold in Germany and

now almost completely taken over by Bellows-Eisenwerkzeug E.G., of Stuttgart and Cobas 4, ordered exclusively by the Swiss forces for the moment.

Both models are wire-guided, and used propellant rockets for power, and are fired and controlled by a single soldier using a manual control box with a single joystick. Both weapons are light and designed for carrying by an individual, just as he now carries a rifle, automatic rifle, mortar, bazooka or other weapons.

Development of this series of weapons was close joint and without government financing by the Swiss firms of Commen AG, Zerach, and Werksausstattungs-Gerlinde, Giviklen, Bielefeld & Co. The Cobas I, sold to Germany for troop trials, is being built

and developed further by Beckhans' firm, one of the units of the German Flugzeug-Union-Bld.

### Cobas I

Effective target range of the Cobas I is about one mile in powered flight, and maximum range is about 300 ft more. Flight speed is about 150 mph.

Combat firing of the weapons follow the conventional procedure for such missiles. The gunner picks his firing position, sets up and waits for a target of opportunity.

Cobas I is now packed into a foam-plastic container, weighing a total of about 32 lb., of which 28.5 lb. constitutes missile and control system. The box is divided into four segments, one of which supports the rocket body when

# Electra/Flight

"Good Neighbor" Jet Age Service Even to Smaller Communities

## YOU'LL HEAR THE DIFFERENCE

A "Good Neighbor," the 4-engine Electra is actually quieter than today's piston-powered transport during taxi, take-off and flight. Because the

prop-jet Electra gets higher faster on climb-out, its presence is unobtrusive—the Electra truly is a good neighbor.



### No Unnecessary "Weather-Ahead" Delays

Electra's 4 General Motors Allison Prop Jets give the "bite" necessary for safe, easy maneuverability even in small airport operations during adverse weather or low ceilings. The Electra's large fuel capacity enables it to fly, if necessary, to alternate airports as far as 600 miles distant and still retain 2 hours of reserve fuel.

### MINIMIZES MECHANICAL DELAYS

Electra uses plug-in system units such as fuel pumps, hydraulic check valves and electric relays...with many parts interchangeable. Packaged service centers are "man height" with operating equipment displayed for easy access and quick checks and adjustment.

Optional self-contained starters and built-in stairs reduce ground equipment needs to a minimum. Air conditioning continues to function on the ground for passenger comfort.

### fits more airports

Today's facilities at more than 1200 world airports are entirely adequate for Electra/Flight service today.



### FITS TODAY'S TRAFFIC CONTROL SYSTEM

Control tower people like Electra because it fits into today's traffic control system...no radical approach or landing or take-off problems. Electra's fuel capacity enables it to "hold" for as long as 2 1/2 hours. On "man-ath" there is practically no "log" between signal and maneuver.



### SAVES TIME ON THE GROUND

Passengers can get on and off the Electra close to terminals at all airports. They can carry their baggage for swift gateway.



### Purchased by:

Aerovias de Mexico • American Airlines

Ansa/ANA of Ansa

Braniff Airways • Cathay-Pacific Airways

Eastern Air Lines

Garuda Indonesian Airways

KLM Royal Dutch Airlines • National Airlines

PSA - Pacific Southwest Airlines

Western Airlines

## LOCKHEED ELECTRA

The finest short-to-medium haul turbine-age airplanes—designed to assure you maximum return on every operating dollar.

LOCKHEED AIRCRAFT CORPORATION, BIRMGHAM, CALIFORNIA





## Newest commercial jets to get "double starts" from Jupiter® turbines

**DESIGNED SPECIFICALLY** for planes of the jet age, Solar's gas turbine-powered ground support units offer faster, easier, more economical starting for America's newest jet airliners. Among the first to use the units will be Douglas DC-8 and Convair's new 440—both of which require large quantities of compressed air to start their high-thrust jet engines.

Capable of starting two engines at once, the units offer substantial savings

in time and fuel, as well as additional power for air-conditioning and pre-flight checks. They are easy to maintain, start instantly under severe temperature extremes, can be operated on almost any available fuel.

In volume production at Solar, the powerful starting and servicing units are marketed for all-the-shaft delivery to airports, airlines and military aircraft and missile installations. They are mounted on self-propelled vehicles,

small trucks and carts, and on small boats to service advanced jet airplanes. For complete information write to Dept. F-36, Solar Aircraft Company, San Diego 16, California. We'll include a free, illustrated brochure.



## AVIONICS

### Computers Learn Engineer's Language

By Jason A. Fines

Large, high speed digital computers are learning the language of the engineer as part of the effort of computer designers to improve the performance of the most indispensable component of present-day computing systems—the human being.

Human beings, according to one study, average one error in every 650 mathematical operations, while a punch-card operating computer is virtually error-free. Therefore, designers are attempting to lead the engineer in doing the creative thinking that only he can do, while relegating to the computer the routine translation of engineering problems into computer language for working out the solutions.

Technique for doing this consists of writing special programs for large computers to convert words and numbers entered verbally by the engineer into the alphanumeric and coded areas of letters and numbers that comprise the machine's own language.

At present, the best known systems for automatically translating the engineer's version of the computer program into machine code are International Business Machines Corp.'s "Natural" (known) translation and advanced version will be available this fall called "Natu" and Sperry Rand Corp.'s "Math-Matic." Similar systems are available for automatic coding of computer code for business programs.

#### Engineer Progresses

Continuously, an engineer with a problem to be solved on a large digital computer must program it himself which requires that he learn a highly complicated programming technique or he must refer it to a programmer who must know enough of the complexities of his problem to program it intelligently for the computer.

Sperry Corporation is attempting a solution to this problem with the addition of the Math-Matic automatic coding system to its Univac computer system has found that its engineers can learn to program their own problems within a few days' time from study of the Math-Matic manual, so that most problems require only that a programmer check the program for certain errors.

Sperry says that several advantages have accrued from this approach. The need for programming has been reduced, but even more important the



UNIVAC condenses wireless control panel (topground), computer and tape handling equipment.



SPECIAL operator plots program automatically on computer tape (types paper copy below). High speed printer can print computer output at 600 lines per minute (below).



## Things to Come ?

A team of experimenters performed last year at the laboratories of the International Business Machines Corp. had obtained with automation, a virtual student, Richard Froberg, working at the laboratories during the summer explored the use of "learning theory" as applied to a digital computer.

Using an IBM 704 computer, Froberg had simulated a very simple and self-correcting switch that will take four kinds of codes, a maximum length of program of 64 instructions, and a memory consisting of 64 one-bit words. The very simple computer, which he called "Hercules" exhibited the ability to "learn."

He studied the simulation on the IBM 704 at the same time as of students which told Hercules if it had made a mistake or not, and a bookkeeping system which listed its success and failures. Hercules was not told whether a worded out of instructions had been chosen but simply if a correct answer had or had not been produced.

If Hercules made a mistake of one, as which, probably, if it got the right result it was, as effect, rewarded. The way done by attaching a success number to each of the instructions that depended on the result of failure, awarded to not be successful, or by the two marks of double space. In the event of 64 failures, the computer of the instructions with the lowest success numbers would be replaced with new, random instructions with arbitrary assigned success values.

When failing, therefore, Hercules received constant changes in program, while instructions learned operating progress were rewarded with larger success numbers. By this method Hercules was able to learn to do a number of things and to do them without being told. The computer learned which words in its memory were the most from the outside world and which words were the output. It learned to insert a number from the input to the output. It learned simple logical addition and to place the result in the output. Most important of all, the computer demonstrated its ability to learn to do new things on repeated occasions. . . . steps in a small of novel and problems.

engineer learn the capabilities of the computer and consequently is limited by possibilities of using the computer in one area and the problems that have not previously been handled symbolically.

Except for problems planned well in advance, and which require long enough computer time to make conventional coding advantageous, engineers now use MATH-MATIC almost exclusively for engineering problems to be solved on the machine. (The computer also is used for plotting and bookkeeping purposes.) The company says that it will have been a lesson received in the use of the computer.

In particular, automatic coding has been desirable for the kind of rapid and intensive engineering work that generates a technical proposal, and for analyzing unexpected problems that arise while an engineering development program approaches its deadline, according to Spurr engineers.

Typical problems for which Spurr has applied the automatic coding technique include computation of infinite matrices, gas duct problems in nuclear guidance systems, comparison of specifications in material and mechanical design, Fourier analysis of electrical networks, comparison of electronic paths and other calculations in traveling wave tubes and klystrons, radar antenna design, and design problems of special purpose digital computers.

Credit for the last important work

in automatic coding is attributed generally to Dr. Grace N. Elgort of Spurr Rand Corp. Since 1957 she, more than 80 of these automatic coding systems have been developed both for scientific and business use by computer system designers and their customers, including manufacturers, large corporations, and financial and government research laboratories.

Generally, these systems were developed to help solve specific types of problems on a specific type of computer. The advantages, however, of a coding system capable of expressing all but the most difficult problems out of reading an computer anywhere in the country are being demonstrated as yet a very few systems.

At the same time, these advantages are impressing computer manufacturers with the desirability of standard computer configurations and are the reason that several manufacturers systems are under development that will convert a problem from one automatic coding language to another. For example, Xerox into MATH-MATIC.

An advanced example of this trend is the program at the University of Michigan to develop an "evolutionary-analytic" translator, although cost and complexity would limit the application of such a program to a few installations. Probably the ultimate program underway today is at the Massachusetts Institute of Technology where an automatic operator is being developed to

automatically check made by computer operators instead, the automatic operator will be given 12 hours' work and left to its own devices.

Attempts to help solve the most pressing problems of new computer use had most complex computer jobs less through development of a more mature automatic coding system and the exchange of information have resulted in the formation of cooperative groups over the past 10 years. These groups have been of major importance in the evolution of automatic coding.

• **Pact Group:** Composed of Douglas South Maines, El Segundo and Long Beach, Lockheed, Naval Ordnance Test Station, Inverness, North American and Bend Corp., the Pact Group developed an automatic coding system, known as Pact 15, which is of special interest because it was the first major cooperative coding effort.

• **Share Group:** The Share (Stocks to Help Avoid Redundant Effort) Group was founded in an association of IBM 704 users. The cooperation only used by the group, called the Share Symbolic Program, was the work of Roy Watt of United Aircraft and, also, served as the base for the Fortran system developed by IBM.

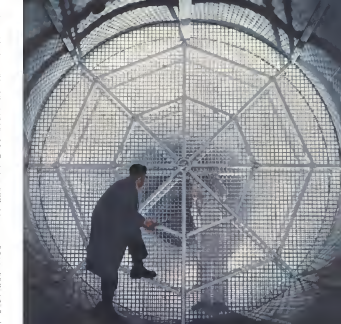
IBM has estimated that use of the Fortran system reduces programming costs and elapsed time of programming by a factor of 10 - 1 over that required by machine language coding, and by a factor of 5 - 1 over that required for coding in high symbolic language. Similar reductions would be expected from a system such as Math-Matic.

### Computer Problems

The engineer faced for the first time with the problem of programming a computer usually encounters three or four major difficulties in program as an successful if he only up learning how to solve the problem but the machine does not. Learning how to solve the problem is not the same as knowing the logic of the problem, and the rest part of a computer can be automatically open areas of data-to obtain useful data be most hard to be especially difficult about what he asks for in a solution.

In describing automatic coding systems, there that should be defining one.

- **Program:** A program is a set of instructions given to a computer.
- **Programming:** Programming is the translation of a mathematical problem into language acceptable by the computer.
- **Routine:** Routine is a common work program.
- **Subroutine:** A subroutine is a portion of a program and runs that once in that program.
- **Assembly program:** An assembly program combines separate pieces of code



## INTAKE TO THE FUTURE

Beyond this screen, which straightens turbulent air flows, Greende can test run diesel engines in an atmosphere equivalent to 100,000 feet of altitude.

This new high altitude tunnel is another of the major programs at Greende for research into air-breathing engines over the widest range of speed and altitude.



**RENDINA ENGINES LIMITED** MALTON, CANADA

MEMBER A V.ROE CASADIA LIMITED & THE HARKER SHODDLEY GROUP



# in missiles...

among scientific, military,  
government and industry men . . .

## Aviation Week is first

In the rapid-paced, dynamic field of space technology, missiles have captured the imagination and attention of the world. And because Aviation Week editors were on the scene when the first missiles were developed, they know what efforts in research, development and engineering work lie behind the missiles now on the way up. This perspective, the ability to correlate, this awareness of a great industry behind the biggest headlines and smallest component account for Aviation Week's accurate reporting of current events and deep insight into the future.

Aviation Week has been a part of the big events in space technology—Aviation Week editorial firsts include such memorable missile articles as: *The Anti-Missile Missile* (4/9/56 issue), *How U.S. Tops Soviet Military Secrets* (10/21/57 issue), the two authoritative series on missile guidance—*Inertial Systems* (January 2, 9, 16 & 23) and *Infrared* (March 4, 11 & 18 issues)—and annual coverage of the International Astronautical Federation since its founding in 1950. Aviation Week features have shaped both technical thinking and defense policy.

Aviation Week gets there first—to the events, the people who make the events happen, to the interpretation behind the events. And its weekly format means that technical information arrives fresh, in time to be meaningful.

This kind of on-the-spot coverage has paid off in world-wide and industry-chief audiences—has made Aviation Week the most quoted publication covering missile progress—and all phases of the aviation industry. During 1967 alone, more than 368,000 AW reprints were bought by U.S. and foreign manufacturers, military and government agencies, universities and scientific institutions.

First in Space Technology, Technical Coverage, Editorial Quality and Impact, Aviation Week is number one among Aviation Technical and Management Publications in Circulation, World-Wide Distribution and Advertising Income.



**Aviation Week**  
Including Space Technology

A MCGRAW-HILL PUBLICATION,  
330 WEST 42nd STREET, NEW YORK 36, N. Y.





### Phase-Lock Demodulator

New phase-lock demodulator for use with telemetry receivers, provides at least 4 db improvement in receiver sensitivity for FM/FM receivers, according to Rockwell for which developed unit. Model 3100 phase-lock demodulator can be used with various telemetry systems with little or no modification. Receives into Acousto-Optic The Vanguard coherent pulsometer gain, output ports. Address: P. O. Box 57, Melbourne, Fla.

ing into a single set of instructions, normally concerning arithmetic language to machine language with a one to one correspondence.

• Computer programs. A computer program substitutes out symbolic language for another with a one-to-one correspondence.

For example, the Math-Matic system used with Unpac I and II computers (called the AT1 code) converts the coded program to an intermediate code (AI) which in turn translates the program into the C-10 machine code of the computer.

The base C-10 code is written 12 characters to a line using both letters and numbers, but instructions to the base.

The AI intermediate program codes are assembled and a computer program, it accepts the more sophisticated AT1 Math-Matic code, translates it to a machine readable language and converts this simpler code to the C-10 machine code of the computer.

Using the Math-Matic code, an engineer wishing to add X plus Y would write the program as:

Z = X + Y

This program when translated into the computer would be converted to AI code as:

ADD10 ADD15  
where ADD would be the instruction to add, 1011 the symbol for the constant memory position where the value for X is stored on this example 1011, 010 the symbol for the memory position for Y, and 1111 the symbol for the memory position where the answer will be stored.

The AI code would then be converted to the C-10 machine code. Because both AT1 and A5 are floating decimal systems, the C-10 code will be

## Sylphon® Seals for HOT SPOTS

Many of the newest fuel controls and fuel pumps are using Sylphon Vee-Face Seals to successfully overcome elevated temperature and pressure problems. These all metal seals provide positive static sealing at temperatures from -60°F. to +800°F. and pressures up to 1000 psi. Sylphon Seals are corrosion resistant and maintain their resiliency in both storage and service.



WRITE TODAY FOR BULLETIN LAR2

**BELLOW TYPE ROTARY SEALS**  
for redesigning existing and the original fluids or gases... Available also in special sizes to 26,000 R.P.M.



**Robertshaw-Fulton**  
CONTROL COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tennessee

in this system. In this example, would require as many as 50 lines to write. If the values were in fixed point notation, the C-10 code would read:

801170 00106  
801170 00000

The last instruction 801170 directs that the value for X be stored in memory position 170 to be brought to the accumulator, second instruction 801106 that the value for Y stored in memory position 106 be taken and added to the number in the accumulator, third instruction 801170 that the sum be stored in memory position 175. Series of six zero code for computer to pass out to the next instruction.

As part of the flexibility of the system, it is possible for experienced programmers to write a special program for problems beyond the present Math-Matic capability by directing the computer to accept portions of the program, such as the intermediate AI code or to the conventional C-10 machine language code.

In the Math-Matic system there are three types of systems:

• **Input/output systems** receive data to be read into the computer system from magnetic tapes or information from the memory to be written on tape.

• **Control systems** determine the various paths taken through the program as it is run.

• **Equation systems** are stated in specific algebraic equations subject to certain constraints of the system.

This automatic coding system, and other major features apparently will not only reduce the time and cost of programming large digital computers by as much as 40% but, at the same time, will provide an increasingly large group of engineers with the opportunity of exploring new and complex problems by using this powerful tool.

## Light Beam Method Measures Gravity

Scientists of the Coast and Geodetic Survey, Department of Commerce, and the National Bureau of Standards have developed a new method of measuring gravity that will be more precise and compact. Beams of light are sent through a hole, creating a small quantity of tapered refraction (or light) method.

Measures in which light is absorbed indicates strength of magnetic field because absorption of light depends on spacing of electrons in molecules, and spots are then controlled by the magnetic field. One suggested application is in probes to measure the magnetic fields of outer space, and to solve problems of whether moon has a magnetic field or not.



16

**AMPEX**  
CORPORATION

## New airborne Ampex... the 800-B

Improved version of the world's most widely used mobile tape recorder

For airborne or mobile data acquisition, the Ampex 800-B combines newly available component hardware, improved design details and the time-proven cast of excellent basic design. It is a new recorder - yet a known quantity well past the shadowless stage. The "B" inherits the experience of the hundreds of Model 800s already in active service. Its complete specifications are available now. And before each Ampex leaves the plant, it is proved in performance tests, equipping or exceeding all published specifications. The Ampex 800-B is in quantity production and is available on a reasonable delivery schedule.

**Handle Ejector Components**, the newest in micro-miniature, provide rugged, shock-proof protection, yet still fit into the recorder.

**New advantage tape** eliminates hazard of machine personnel handling with standard systems by being as it is releasing charts as it is.

**New fast forward** switch permits recording tape to be run quickly onto idler and open reels when not needed. Reel-to-reel control is located in transport.

**New read control** operates the second read of the transport. Remote control unit as provided to before and isolate power and record switches, and remaining tape indicator.

**Interchangeable amplifiers** provide FM systems. Element in FM recording (later not selected by switch on the same amplifier module). Two to 12 tracks accommodate hundreds of multitrack data channels in the DAC to 200,000cps range.

**Meets airborne requirements**, ready to fly, performing within specs at 2000 feet per minute - 60" to 1,200", altitude to 50,000 feet, weight 100 pounds for a complete track system.

**High-quality performance**, compatible with and already supporting Ampex's logistic maintenance in Britain, Europe, Japan, and throughout the world. Complete literature upon complete data.

**For complete information, write Dept. 1000, AMPEX CORPORATION, 650 CHANDLER AVENUE • REDWOOD CITY, CALIFORNIA**  
Please give Ampex this coupon. No personal data to be given, including name. 200001 1/66 (also the Great States of Canada. Foreign correspondence from the first world.



## No other missile test lab can do all the things we can do

Take our 100-foot test tower. With it we can simulate the pressure and aerodynamic loadings that occur during the actual launching and flight of a missile.

This is just one of the many specialized facilities and tools that we have built up in the last few years. During this decade—because of our complete responsibility for the development of a major weapon system—we have also piled up a wealth of experience in many related fields.

The spot of this is that we can handle any project from far-out basic research to static and dynamic testing of complete aircraft.

For example, we can analyze aerodynamic heating and loading at the same time...on a complete wing or a large section of heating. We've also been at applying heat gradients from leading to trailing edge and spanwise. And we are equipped to compute temperature distributions and to predict specific area temperatures.

We're completely qualified to work with any kind of metals or alloys, composites and composites, electrical, hydraulic and pneumatic systems and systems, air motion, reliability, environmental testing (including re-entry), and instrumentation.

Now we'd like to solve your problems. The weather the better.

Please write to E. E. Schmitt, Missile Division Test Lab Manager, North American Aviation, 22214 Lakeside Blvd., Downey, Calif.

### MISSILE DEVELOPMENT DIVISION

North American Aviation Inc.



## Hidan Utilizes Doppler Radar, Computer

New York—Method of simplifying the air traffic control problem through use of an automatic self-contained navigation system for aircraft has been patented by General Precision Equipment Corp. System combines an airborne Doppler radar with a computer and cockpit display.

By providing a pilot with highly accurate position and flight data, the system—called Hidan for High Density Air Navigation—would enable him to conform to his flight plan with sufficient accuracy so that required clearance altitudes could be reduced while at the same time providing positive separation from all similarly equipped aircraft, according to the company.

Use of Hidan system, however, would not eliminate need for ground equipment used to control unequipped aircraft and to monitor flight plan compliance of equipped aircraft. Also, decreased separation could be allowed only between equipped aircraft.

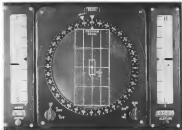
Cost of a Hidan installation suitable for the Boeing 707 would be about \$75,000 for the first 50 systems, company executives say. The price in its scientific aspect of engineering development is undependent on, they state, system cost possibly could drop to about \$5,000.

### Concept Support

Describing philosophy of Hidan system, General Precision's President Edwin A. Levin said, "Airway traffic can be completely and automatically controlled only by a system of self-contained navigation by airplane themselves to work with the new traffic control system of the Advanced Modernization Board...to Hidan we see key to that system. It releases ground services in the location they best perform—that of monitoring the rules of the air and the predetermined flight positions that pilots can take the airplane to their proper destination by means which are automatic and self-contained."

Support of the concept of wider use of self-contained or autonomous systems was voiced by specialists at the recent ASEE Forum Communications-Electronics-Aerospace Symposium-Electronics-Aerospace Technical Division of ASEE, and Lt. Col. D. J. Freund, USAF Deputy Chief of Natick, both predicted systems use of dual releasing computers which would receive inputs from a Doppler radar, from Terrain Profile stations, or from other external aids and then use "best data" as in the Long Range Intelligence (AWW June 11, 1970, p. 73) or USAF's Navstar concept.

ASEE suggested that one possibility was to use position data obtained from



precision altitude display could be used with Hidan system to show actual position of aircraft in relation to programmed position. Ground panel as shown at left with scale to show divergence from programmed ground speed, altitude and altitude divergence at right. Movement of small aircraft over the center grid indicates to scale conformity to the programmed flight plan. As shown, the aircraft is off course to the right and behind schedule. Scale of the grid can be used for course time and 10 sec. scale.

ground radar and computer crosslinks to periodically correct the reference computer. While Hidan, as presently conceived, does not include the provisions, company officials say that there are no real problems in including it.

Cost of the Hidan system would definitely be low per airplane on the part of the private pilot. General Precision agrees that it expects all being within the next few years to be restricted to instrument flight rules (IFR)—and that cost of the Hidan system is not out of line with that of other integrated aids.

### System Operation

Hidan radar consists of a mixture of two function computers and:

- **Doppler radar.** Radar Doppler radar, presently being used by the military and undergoing evaluation for commercial use, provides ground speed and drift angle as inputs to the reference computer. Radar weighs 55 lb, has accuracy of 0.5 percent for ground speed, 3.1 deg. for drift angle, according to General Precision.
- **Computers and Display.** Computer provides data to cockpit display which indicates aircraft position continuously and, when programmed for a flight by insertion of flight plan data into the computer, continuously displays any divergence of the aircraft from its planned position.

The company has designed a backup cockpit display as one method of pro-

viding the data required by the pilot to correct any divergence from course or flight plan. Company engineers, however, have emphasized that the choice of a lead design should be coordinated both with the customer and with the intended government agencies.



• **Electronic Gyroscopes—Three** computer shafts have substituted components to Wright Air Development Center for electronic gyroscopes without moving parts (AWW Mar 24, p. 27) on General Precision Laboratory, Collins Industries and W. L. Mason Corp.

• **More Funds for Micro-Modulars—**Army is prepared to raise the state on as project \$5 million micro-module development program with Radio Corp. of America to do so, as well as \$25 million, if reported (AWW June 9, p. 27). Available funds could go even higher if Air Force and Navy join in support of the program.

• **Defense Electronics Gain—Defense** Department procurement of electronics for last nine months of current fiscal year is estimated at \$1.6 billion, compared to estimated \$2.4 billion for corresponding period in 1970, according



## Motorola's arsenal of electronics

### You can depend upon Motorola for complex weapon system design and development ...

... for Motorola is the world's largest exclusive electronics manufacturer... with decades of experience in the design and development of complex systems and adaptations... a stable engineering force of teams built up over the years with long term consistency and growth in complex system development... throughout to work together towards the same goal of practical, reliable operation.



**MOTOROLA Inc.**

MILITARY ELECTRONICS DIVISION

Chicago Area Center • 2719 N. Clybourn Ave. • Chicago, IL  
Western Area Center • 2221 McDowell Road • Phoenix, Arizona

Motorola engineers and scientists have made important contributions to the General Service Joint Air, Sea, and Land studies, the A-10 B-9, F-15 and other complex systems systems.

in Electronic Industries Association Association's reports are based on statistics of total production of aircraft, missile expenditures for electronics.

• **Digital Computer Simulation—**Consolidated using in time and cost of development, digital simulation is claimed for new digital computer analog simulator developed by Stanford Research Institute. New SRIL has universal error program permits engineers to set up wide variety of digital networks for series of playback. New device was developed by W. H. Koels of SRIL's computer laboratory.

• **Price of Solar Energy—**Power cost of silicon solar cells now about \$75 to \$100 per watt of generated power, based on current production cells with conversion efficiency of 10%. Heliose Electronics has achieved efficiency as high as 14% in laboratory units. Top theoretical efficiency is 22%.

• **Republic Builds Plastic Antenna—**Lightweight directive plastic antenna, spaced with metal coating and designed to withstand blast pressures as high as 150,000 lb., will be constructed by Republic Aviation Corp. Antenna is being built for Republic's use in an advanced missile system.

• **Boeing Opposes Doppler Shift—**Boeing Aircraft Co. has joined Avco, McCombs Associates, Radio Shack, Collins Radio and Douglas Aircraft Co. in filing petition with Federal Communications Commission opposing recent action in shifting frequency of civil Doppler anti-air warfare from 8.320 mc to 15,000 mc. (AW Nov 26, p 13)

• **Signed on Dotted Line—**Major contract recently awarded, anticipated by many manufacturers include the 64-1040.

• **Kalkelec Instrument** has awarded \$4.4 million contract from Sperry Corp. for extra radars (estimated production devoted for use in B-1E (Starliner) navigation system.

• **Law, Inc.** reports \$4.1 million Army contract for automatic flight control for use in Sikorsky HO4 helicopter.

• **Sonocochemicals, Inc.**, New Haven, Conn., will develop air data computer and wind yaw transducer for F-10-1 radar (now \$170,000 contract from Chance Vought).

• **Ryan Aeronautical Co.** is producing AN/SPN-97 Doppler system and Sikorski Avcolec contract for use in new HSS-1N helicopter. New SPN-97 weighs approximately 30 lb.

• **Epaco, Inc.**, Boston, will produce transistor-magnetic switch computer for new Navstar electronic in satellite process opposite platform.

• **Berkson Instruments'** custom development, Anaheim, Calif., will produce data processing system for National Advisory Committee for Aeronautics to be used in studying wind tunnel data at NACA's Langley Aeronautical Laboratory.

• **Packard Bell Electronics** reports a \$250,000 contract from Army Signal Corps for airborne IFF identification, friend or foe engagement.

• **Low Altitude Division** has received \$300,000 contract from Army Ballistic Missile Agency for "barrier improvement" of work making gun for use in slugging missile control guidance system.

## NEW AVIONIC PRODUCTS

### Components & Devices

• **High sensitivity electronic silicon diode**, Type MA-51L, can provide system noise figures between 1.5 and 3.5 db over the entire 50 to 75 khz range when used in matched pairs in balanced mixer assemblies in conjunction with a low noise IF amp, according to manufacturer's estimates. Unit can also be used as a high sensitivity detector in low level radar receiver applications. MA-51L requires no mount, is bolted

### MAJOR INTERNATIONAL CARRIERS SELECT



## LORAN

FOR JET-AOE LONG RANGE NAVIGATION



QANTAS



SABENA

LORAN has long been recognized as the reliable, highly accurate system of long range navigation. LORAN is already approved and in service over North Atlantic and Pacific air routes, with proved sea expansion planned to cover other important areas, too.

Now, LORAN becomes an even more practical navigation system, with the development by Edo of a lightweight, lightweight, portable unit. This compact equipment, weighing only 26 pounds (including sea mount) in the cockpit. Proven by production tests and kind of positive laboratory, without having to consult tables or make complicated calculations.

Successfully tested in three-carrier operation, Edo LORAN has been ordered by Pan American, BOAC, Qantas, Cebuana and other airlines as their approved form of Ensign and Doppler air assistance. Many other international carriers have also indicated their intention to use LORAN to ensure precise, reliable long range navigation.

#### EDO AIRBORNE LORAN, Model 200

Model 200

Control panel and 4 1/2 inch radio receiver mounted for operation by pilot or copilot. Receiver fully complete with 200 lbs. installation of complete system is only 26 lbs., and compact unit requires only a small fraction of space formerly required. Designed and manufactured by Edo, a major supplier of advanced electronic systems for the U.S. Navy—radio, radio, ADF equipment.



For the complete data on Edo Model 200 Airborne Loran and for Technical Manual PSL-1, Dept. C-1



Edo Corporation

College Park, Maryland, U.S.A.

Member of the Edo Group of Companies and a Division of Edo Corporation, Inc.

FROM  
**ASCOP**



## THE NEW MINIPLEXER®

### TINY SAMPLING SWITCH — TREMENDOUS PERFORMANCE!

AN IMPORTANT ADDITION TO THE FAMILY OF  
**SMALLER • LIGHTER • BETTER**  
COMPONENTS

To the world of down-the-hole sampler components, ASCOP now adds the **MINIPLEXER®** — a revolutionary sampling switch that does a fairer job more reliably. The **MINIPLEXER** is the ideal component to the transmitter, diode and the closed circuit for solving today's critical sampling, weighing and power saving problems.

This tiny three-deck multi-plate device contains 60 wafers, providing 30 channels of before-before-make operation. It weighs 2.37 grams, is 1/8" of an inch long and 1/4 inch in diameter. Yet, it will give longer service-free life and operate under more extreme environmental conditions than the much heavier, bigger switches it replaces.

The secret of the **MINIPLEXER** lies in exclusive ASCOP **DURAPONT®** contact pins, developed through extensive metallurgical research. The pin material combines resistive

weariness and low friction coefficient, permitting tiny miniature design with low permanent wear speeds and longer life.

The **MINIPLEXER** is one of a family of manufactured ASCOP **DURAPONT** switches that will meet the ever widening range of toughest design requirements for your data and control systems. This family of modules also includes complete pulse telemetering computer packages. For further information, contact any of the ASCOP offices listed below or write for Bulletin No. EM-300.

#### ENGINEERING DATA — **MINIPLEXER**

Service-Free Life ..... 500 hrs at 30 RPS  
Contact Temperature ..... -125°F to +125°F  
Resistance ..... 100 to 2000 ohms at 25°C

© 1970 ASCOP

## APPLIED SCIENCE CORPORATION OF PRINCETON

ELECTRO-MECHANICAL DIVISION

GENERAL OFFICE: PRINCETON, NEW JERSEY

#### REGIONAL OFFICES

PRINCETON, NEW JERSEY, P. O. Box 40, Burlington 7, N.J.  
CINCINNATI, OHIO, 1 N. Main Ave., Care Bldg. 300

NEW RIVER, CALIFORNIA, 12071 Colton Rd., Suite 2000  
BALTIMORE, MARYLAND, 4710 Greenleaf Ave., Entrance 1-1000

## AERODYNAMICISTS & STRUCTURES ENGINEERS

Here are interesting  
openings on advanced  
**VTOL Projects...**



similar to RG-95/U waveguide ferrite IF or video output coupling in the output of a miniature Microtron oscillator on the top face of the die. Dimensions are 0.710 x 0.767 x 1.994 in., mounted to top of connector. Micro-wave Associates, Inc., Burlington, Mass.

• **Subminiature feedthrough terminal**, Type FT-50143 MIL, uses Tellex Electronic for "press-fit" installation. Terminal ends are ground and drilled for reattachment as well as solder bond.



Available in two colors for color coding, terminals measure 0.095 in. blanking diameter by 0.100 in. long, or 0.161 in. overall including end legs. Schleicher Corp., Mansfield, N. Y.

• **High resolution color picture tube**, Type WX3751, is used to have three times the resolution of any picture tube. It provides 667 lines to the inch, or a scanning line only 0.0015 in. wide, across the 5 in. diameter. The plate is optically flat and made of pure glass to



ensure contrast, and a modified P-11 blue phosphor and a metal backed screen to obtain maximum light output. Tube is 17 in. long and is of electrostatic focus, magnetic deflection type. Westinghouse Electronic Tube Division, Westinghouse Electric Corp., P.O. Box 284, Elmira, N. Y.

Bell Aircraft is making steady progress toward the development of high-performance jet aircraft which will take off and land vertically in a conventional attitude. Two test vehicles, one of them the X-14, have been flown successfully.

Expansion of this VTOL program has created openings for experienced aerodynamicists and structures engineers with experience in these fields:

- Flight and Vibration
- Propulsion Systems Design and Analysis
- Aircraft and Installation Layout
- Structural Design and Analysis

Here are challenging, long-range opportunities to participate in the development of the planes of tomorrow. Top dollar salaries and benefits await a wealth of room for rapid advancement. Please write: Supervisor of Engineering, Employment, Dept. E-11, via airmail correspondence, P.O. Box 1, North 0-N, Y.

**BELL**  
Aircraft

## Turbojet Temperature Analyzer Scheduled for Flight Test in 707

Woodbridge, N. Y.—Jet engine turbojet analyzers for turbojet and turbo-prop engines developed by Avco, Inc. (being installed) by Pan American World Airways and other airlines. It is slated for flight test on Boeing 707 jet transport.

Temperature analyzer differs from gasometer and air-fuel balancing type engine temperature ratio gauges, in that it utilizes a cathode ray tube display to provide continuous monitoring of individual thermocouple readings as well as the average temperature of a thermocouple ring. Thermocouple display permits monitoring of individual thermocouples without manual switch key by the operator or installation of analogic dials. The cathode ray of radius, but spots or other engine time profiles, disappears throughout the instrument's stage of use to 1,200°C.

Problem of secondary jet engine difficulties and their pickup is minimized by constant fluctuation in fuel to a main engine supplies less fuel than the engine detector to the analyzer. Location of thermocouple and jet position within the sensor permits proper fuel to be used for the majority of the tests.

Another capability of the instrument being emphasized by Avco is its ability to supervise other parameters, of which vibration is probably the most important. Adaptation would include a control panel of additional warning elements, selection switches and calibrated auto-alarms. Airline attitude toward vibration is so drastic of the accidents with which jet operations are being approached. Avco engineers say that some lines are not sure whether frequency or amplitude

ratio measurement would provide the better index of engine malfunctions.

Analyses suit control of two main components of the sensor-analyzer and the cathode ray tube indicator. Scan mechanism, which can be located in either fire wing or fuselage, receives the thermocouple leads.

In operation, the analyzer sequentially samples temperature signals from each thermocouple. In excess of a motor-driven scanning switch and converts the outputs to a train of voltage pulses, each of a magnitude proportional to temperature of associated thermocouple. Switch, which rotates at 60 cps, is designed for a minimum stress rate for of 1,000 Hz.

Horizontal sweep voltage required for cathode tube display of thermocouple signals and a reference line are controlled by a 100 cps potentiometer coupled to the scanning switch and driven by the same motor.

Reference trace, positioned by a computer, provides source of difference temperature of any thermocouple (plus or minus) of pulses. Computer is on the analyzer panel and calibrated in degree Celsius. Switch voltage current within the sensor is transmitted between temperature pairs to provide the reference trace. Long persistence tube phosphor screen provides continuous display of temperature pairs and selection lines.

Indicators utilize a 150V cathode ray tube with display area measuring 21 in. wide by 12 in. high. Screen can be used to measure a temperature signal of 1,000°C or adjusted to display area band of 100°C within that 1,000 deg. spread.



JET engine temperature analyzer unit consists of sensor-analyzer (left) and cathode ray tube indicator. Total weight of instrument unit is 6.6 lb.

beam width of 0.025 in. (2.6C) provides stability comparable to conventional display.

Each engine display is controlled by a three-position toggle switch enabling operator to select normal, average, cruise, or idling signal engine display. An indicator of thermocouple malfunctions is accomplished with precision warning signals within the thermocouple circuit.

Analyses unit standard model 115 V, 400-cyc. current for its operating power and operates under constant aural condition conforming to MIL-F-1572A. Weight of the instrument unit is standard 5.9 lb., indicator 1 1/2 lb. Display can be set to reflect a tolerance of  $\pm 2C$  and computer is accurate to 1C.

## Radar Training Aids Put 'Flights' on Film

San Francisco, Calif.—System Development Corp., Camp Pendleton, Calif. division, has become a separate unit here in its efforts to develop equipment for its decade started in developing capabilities of independent firm.

Engaged presently in developing an air training program for existing air defense control centers and planning similar program for advanced defense systems such as SAMGE. System Development Corp. also is working out programming for SAMGE computers.

Company is non-profit, Inc. Based, and is closely allied with various parent companies in handling field orders to its broad of trainees.

Concepts originated in an SDG developed training system for Air Defense Control Center personnel which includes simulated radar warning system, radar control and other aircraft gear within the center, to replace as radar display lights to ADC panelists efforts.

Some in such that while simulation is being led through Center's radar scope, and simulated intercepter jet, such as being mechanically reproduced into the simulator, the radar panelists need be part of the problem, more can stay on actual area duty. In case of necessity, switch can be thrown to erase all the simulation from Center's gear, retaining all elements to complete an definite situation.

Gifted System Training Program (STP), its required hardware has been identified as more than 150 radar stations throughout the U.S. and probably will be installed in others outside the U.S. in near future, such as at Dow Lake, Newfoundland and Gloucester Island.

STP panelists are made up of film, which is led through SDG developed



## Sud Valtiguer Enters Flight Test Phase

but Avior's SE-116 Valtiguer, shown during initial flight, will be powered by two Turbomeca Turbo-prop engines producing 740 city-shp. Powering will be the Curtiss Wright R-1820 for 200 hp. Preflight paid off of wing is good look. Aircraft will be used for island support and liaison, but have cruise range of about 200 miles. Landing gear is tricycle type.

equipment to produce desired target on radar screen. Parallel with these are appropriate scripts for three man being intercepter pilot, other related functions, to follow throughout specific positions. Routine is controlled by inclusion of control ground clutter and air traffic background performance to the status for which the problem film is made up. Further action is aided by electronic superposition of current position on the problem.

SDC has, in addition, a bank of more than 70,000 "flights" upon which problem can be based. These "flights" consist of recorded data on traffic at hundreds of U.S. and foreign sites, under all circumstances. As an example, should New York area be closed by inclement, and traffic analysis the area at high altitude, this can be made a part of the problem, along with the proper traffic density appropriate to the time of the day. This can be obtained in advance intracoastal work characteristics of a high speed, high altitude jet bomber, or even other type aircraft, based, from DC-7C to Russian Il-28s.

Equipment necessary to stage a problem of its actual ADC installation consists of an AN/SP-17, problem to be simulated, and a 1510C pilot signal generator, plus associated peripheral equipment. The problem reproduction was in SDG design and development, the 1510C unit was designed with SDG involvement. Two primary equipments and the required additional gear, plus scripts for intercepter pilot and other participating such as an air division, headquarters in CAA, are made up by SDG in a package for each aircraft control and warning system.

which uses the system training program.

In addition to its problem package efforts, SDC also is engaged in long-term problems abstract of new developments in sensors and weapon systems. Presently, company is studying ways to properly train personnel for ADC work with SAMGE computers. SAMGE users must carefully adhere to limits of radar function in terms of ADC problems such as tracking, estimating speeds, courses, other data, accurate data functions which are the limits and more accurately, and better decision making to human.

SDC is developing the proper programming for SAMGE computers, according to factors involved. It has a contract to develop basic air defense computer program with its adaptation to the first three SAMGE units in a joint enterprise with Lincoln Laboratories. SDC also is responsible for subsequent adaptations of each SAMGE computer to its particular site, and for installation of that adaptation with the computer at their site. SDC also is responsible for maintenance of SAMGE computers at each site, and routine and updating of SAMGE computer program of each site to account for changing intelligence in aircraft and weapon status.

At its site here, SDC has a newly constructed simulation facility for its ADC work. Facility has two laboratory rooms adapted to its aircraft control and warning system (interceptor center site, with appropriate gear installed, all under operational configuration. There is room for electronic equipment to support the new laboratory center, a room where intercepter simulation work is accom-

plished, rooms and corridors with one-way windows which are used to monitor the ADC team working each intercepter center. Additionally, a debriefing room is adjacent to each laboratory facility is designed so that records of ADC team performance are taken as problem programs, and immediately following an objective critique can be made.

One center is operational at SDC facility now, second will be operational soon. When both laboratories are working, problems will be introduced which are in different levels—two director centers and a director control center. All aspects of problem can be handled, such as lateral padding of traffic, intercepter head-on.

In the simulation facility, SDC has Air Defense Computer personnel in training, also is able to conduct on-site investigations into human behavior at the same time, getting valuable site from facility.

Also incorporated into simulation facility is a SAMGE computer, for SDC efforts in behalf of SAMGE program. Production of Systems Development Corp. a M. D. Koppitz, who was chief of Radar System Development Division. Vice president of SDG is Dr. W. C. Bush, chief of Radar Development Division with SAMGE.

Departments at SDC are: Mission Factors, headed by D. L. F. Center; Public Relations, headed by H. H. Haines; Programming, headed by J. D. Madson; and Engineering, headed by F. C. Sullivan.

Company deals extensively in interdisciplinary fields, seeking optimization of man-machine relationship in its defense problem environment.



**ROLLING OPERATIONS** on T58 compressor blades are performed by friction in 55-ton press (left). Plates are hydraulically opened to position and hold blade during rolling. Follow-up operation (right) shows blade placed in cooling die to provide initial contour.

## T58 Blades Mass-Produced at Low Cost

Jet engine compressor blade and case manufacturing process developed by General Electric Small Aircraft Engine Department requires precision in out-producing costs of these items by some 50% over any other known process, the company reports.

Technique, now in pilot plant stage at GE's Ludlow, N.Y., plant, utilizes a roll and case process and was especially planned for the company's new lightweight T58 turboprop but is readily adaptable to other engines, including the T65 and T64.

Research developed by engineers Gene Bell, Frank Fowler and William

Pfeil, process involves an initial 40 separate operations per blade including extruding, rolling, cooling and trimming with some repetitive steps in annealing and hardening.

Process basically aims to provide a method of forming cast continuously, capability of small blades (overall is a little more than a half inch wide having 0.001-in. thickness on leading edge) formed on large platforms required for fitting to T58's smooth compressor speed. GE engineers reported that blade dimensions of B015 is the most critical for optimum compressor performance.

A feature of the process was develop-

ment of a fixture that takes a partially formed blade, holds it under pressure to prevent a set of roll dies (photo, top left) to move down, push the blade and then roll it. Holding fixture moves back in dies revolve and roll out blade shape. Dies fit tightly onto the blade fllet to form a minimum radius at the photos.



**EVOLUTION** of T58 blade from steel sheet (left) to Babcock molybdenum alloy in 40 operations which can be adapted to automated production method. GE reports, a large-scale output is required. At right, extrusion die is opened to create finished shape.

## WHAT'S NEW

### Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

**Conclusions of Literature on the Effect of Tearing Trajectories on the Mechanical Properties of Wrought Aluminum Base Alloys—**By H. K. Pookford, Lockheed Aircraft U. S. Army Ordnance Corps 55-00, 117 pp. (PB 151555).

**The Effects of Inelastic Action on the Resistance to Various Types of Loads of Ductile Alloys—**Made From Various Classes of Metals Part 7—**Inelastic Behavior of Aluminum After Elongation with Elongation-Free Web Section Calculations.**—By W. J. Yonkers, University of Illinois, and F. D. Brazier, Contract for Wright Air Development Center, U. S. Air Force 51-50, 35 pp. (PB 151556).

**Research and Development Leading to the Establishment of Ultrasonic Test Standards for Aircraft Materials—**By A. D. Coates, R. D. McKinnis, J. C. Fells and W. C. Hart, Ultrasonic Technology and Research Laboratory, for Wright Air Development Center, U. S. Air Force 51-50, 131 pp. (PB 151554).

**Investigation of Fe-Mo-Co-Ni-C System for Heat Resistant and Oxidation Resistant Between 1,200° and 1,600°—**By C. Hsu and R. J. Davis, Crackle Steel Co. of research for Wright Air Development Center, U. S. Air Force 54-80, 153 pp. (PB 151551).

**An Investigation of Three Ferritic Steels for High-Temperature Applications—**By A. P. Colburn and J. W. Frazier, University of Michigan for Wright Air Development Center, U. S. Air Force 53-50, 217 pp. (PB 151557).

**Development of Swedish Construction Inspection Methods, Part 1—**By V. M. Celen, N. Tullin, P. S. Hestergren and J. O. Thorsen, the Ohio State University Research Foundation for Wright Air Development Center 51-50, 98 pp. (PB 151558), Part 2, 51, 25, 45 pp. (PB 151559).

**Calc-Cased Phosphorite Ceramics—**By A. D. Forberg and M. J. Rahn, Naval Research Laboratory, Patuxent, 1955 5-9, 7pp. (PB 151533).

**An Electronic Target Simulator for the Web Operational Radar Surveillance System—**By C. A. Harter and P. Gian, the Ohio State University, for Wright



## NEEDED:

Engineers who don't know "It Can't be Done that Way!"

General Electric's Jet Engine Dept. at Cincinnati now conceives and designs its own Jet Engine controls, accessories, and components, also designs its own test instruments and instrumentation systems. This has created many new problems to be solved, and we have immediate openings for graduate engineers with experience in any of the following fields:

INSTRUMENTATION SYSTEMS  
ELECTRIC CIRCUITRY  
INSTRUMENT DESIGN  
DIGITAL TECHNIQUES  
AEROHYDRAULICS  
ELECTRONIC PACKAGING  
MAGNETIC AMPLIFIERS  
RESEARCH SURFACE CONTROLS

ACTUATION DEVICES  
RELAY CIRCUITS  
HYDRAULIC COMPONENTS  
INERTIAL GUIDANCE  
SERVO MECHANISMS  
FULL CONTROLS  
LOGIC SYSTEMS  
RESEARCH SURFACE CONTROLS

These are career jobs and they pay well for engineers willing and able to work on brand new problems and come up with new answers. Actually, you'll be finding answers that will appear in Tommorrow's textbooks!

If you like the challenge of new problems... if you like to work where Engineers don't know "It can't be done that way"... fill out the coupon below and mail to:

J. A. McGehee, Jet Engine Dept. AW-630  
General Electric Co., Cincinnati 15, Ohio

General Electric I am interested in the possibility of an association with the Jet Engine Dept. of General Electric.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_ Phone \_\_\_\_\_  
Degree \_\_\_\_\_ College \_\_\_\_\_ Date \_\_\_\_\_  
My field of interest is \_\_\_\_\_ AW-630

**GENERAL ELECTRIC**  
JET ENGINE DEPARTMENT  **GENERAL ELECTRIC**  
CINCINNATI 15, OHIO



## Any way you look at it.

Yes, any way you look at the B-58, America's first and only bomber capable of sustained supersonic speeds, you see an aerodynamically-advanced configuration. From the tips of its conical canards wings to the tail of its trim, area rule fuselage... the B-58 reflects the vision, and creative thinking of engineers at Convair-Fort Worth.

Throughout the design stages of the B-58... and in the execution of every one of the more than half-a-hundred Air Force projects now on hand... one major con-

sideration is Growth Potential... the weapon must fly as fast, farther, safer tomorrow than it does today!

Growth potential of a weapons system results directly from growth potential for the individual engineer. If professional growth is a condition of your career plan, send a confidential resume of your training and experience for consideration by employers in the area most suited to your qualifications. For personalized handling address your inquiry to P. O. Box 7454.

**CONVAIR FORT WORTH**  
FORT WORTH, TEXAS

CONVAIR IS A DIVISION OF GENERAL DYNAMICS CORP.

Air Development Center, U. S. Air Force, May, 1957, \$1.00, 79pp. (PB 111504)

Measurement of Detonation Induction Distances in Hydrogen/Oxygen and Acetylene/Oxygen-Nitrogen Mixtures at Normal and Elevated Initial Pressures and Temperatures—by L. E. Schuler and R. Edge, the Ohio State Research Foundation for Wright Air Development Center, U. S. Air Force, June, 1957, \$2.50, 97 pp. (PB 111503)

### Publications Received:

Space Technology—by the Department of Visual Communications, University of Southern California, University of California, Los Angeles 24, Calif. (Kriete) for \$1.300, series of approximately 45 kt Space Technology, is a 17 page issue which consists of lecture by each one of Dr. Winkler von Rosen, Dr. Joseph Kaplan, Dr. H. Strachold, Dr. Maria Sommerfeld and Dr. Wilhelm H. Finkler. Series consists of 45 kt of film, two complete sets of lecture notes will accompany each program.

The Observer's Book of Aircraft—by William Green & Gordon Phillips—Pub. Frederick Warne & Co., Inc., 218 Fifth Avenue, New York 10, New York, \$1.25, 187 pp.

This book contains a detailed report on all recent available aircraft, both civil and military.

The Rocket Engines on the Road to Space—by Bert Williams & Donald Gentry—Pub. John Messner, Inc., 8 West 43rd Street, New York 18, New York, \$1.75, 144 pp.

This book deals mainly with the present of space rockets. It is more at less a history of rocketry.

The Future Man Above—by Lt. Col. Frank K. Everett in collaboration with John G. Dyer—Pub. E. P. Dutton & Co., Inc., 300 4th Ave., New York 10, N. Y., \$1.00.

The story of "Red" Everett from his days as a Army cadet, before joining the United States Army in World War II to his work and career as one of the USAF test pilot group taught and led by Maj. Gen. Albert Boyd, who made such a significant contribution to the development of combatworthy supersonic aircraft. Includes Col. Everett's record-breaking flights in the Bell X-2 aircraft plane.

Project Saturn—edited by Kenneth W. Gifford—Pub. Behrns Book Co., Inc., 122 East 9th Street, New York 33, N. Y., \$3.00.

This book presents the full story of both the Russian and American artificial moons, and also describes the new

## FOR BIG ASSIGNMENTS AND BIG OPPORTUNITIES IN JET ENGINEERING

... Investigate these challenging openings at Fairchild—where pioneering work on small turbines is paying off in astounding success!

- Mechanical Design
- Design Analysis
- Project and Development
- Compressor Design and Development
- Turbine Design and Development
- Performance Analysis
- Control Systems
- Combustion
- Electronic Data System Programming
- Mathematical Analysis

The Fairchild Engine Division offers unlimited opportunities in Research, Development and Production—linked to the requirements of American growth.

One of the most advanced R & D facilities in existence, the Gas Turbine Laboratory is equipped by complete production facilities—meaning they add up to a satisfied personal and comparatively meager progress.

Fairchild Engine Division

**FAIRCHILD  
ENGINE DIVISION**

Genesee Road, Dear Park, Long Island, N. Y.  
Recruiter's Office in Jet Engineering

If you are qualified for a place on our jet engineering team, send us your resume—42 08.



Typical Stalker fabrication. Meticulous assembly of stainless alloy. (Photo courtesy of General Aviation and Engineering Corp.)

Whether you prefer to be an engineer, draftsman and production facilities or an industrial sales, we are always interested.



DEVELOPMENT COMPANY  
514 BROADWAY  
ANN ARBOR, MICHIGAN

### STALKER IS PREPARED

TO SOLVE YOUR  
PERPLEXING FABRICATION

AND BRAZING PROBLEMS

WITH SPECIAL SKILLS,  
COMPLETE TEST AND INSPECTION FACILITIES.

STALKER EMPHASIZES

HIGH TEMPERATURE

BRAZING OF STAINLESS

STEELS AND SUPER ALLOYS.

U.S. AIR FORCE CERTI-

FICATION FOR BOTH BRAZING

AND HEAT TREAT.



simplifies design/procurement!

It's the key to a wide range of pre-tooled filler caps and components. Ultra-adaptable to aircraft, missile, electronic and other actively flaming systems. Many combustion direct drive stacks. Why duplicate? Write for your guide today!

**SPECO**

Steel Products Distributing Co. J  
Division of BETHLEHEM STEEL  
SPH000010.0.000

**Aerodynamic Stability and Control**  
Group leader for advanced guided missile programs to be responsible for complete project analysis, test programs, proposals, analysis methods and design studies. IN 5 derived 7 to 10 years progressive aerodynamic engineering experience with 4 to 5 years in stability and control field.

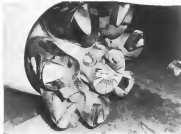
**Aerodynamic Propulsion Design Specialist**—to be responsible for project analysis, test programs, proposals, analysis methods and design studies on advanced guided missile programs. E. S. with M. S. desired 4 to 10 years applicable aircraft or missile experience with three years in propulsion.

If interested, send resume to:

Department of Engineering Employment  
Burr 424.

**BELL AIRCRAFT CORPORATION**

P. O. Box 1, Buffalo 2, New York



### DC-8 Equipped With Rolls-Royce Silencers

Whisper systems manufactured by Rolls-Royce Ltd. have been fitted on the engines of Pan Am's Whittier JTTC-5 (57) turbojet engines on the first Douglas Aircraft Co. DC-8, which recently began flight test (AW No. 9, p. 20). The Rolls-Royce sound suppressors will be used until Douglas' own exhaust silencing units become available.

reducers in inlet and graded intake nozzle that will lead to faster takeoff/climb rate.

**Turboprop Fundamentals**—by Howard E. Moggner-Pub. McGraw-Hill Book Co., Inc., 120 West 43rd Street, New York 36, N. Y. \$1.05, 104 pp.

Basic operation of the element theory and operating principles of the turboprop engine.

**An Introduction to the Dynamics of Aircraft**—by H. Stevens. McGraw-Hill Book Co., 120 West 43rd Street, New York 36, N. Y. \$4.95, 272 pp.

This book deals entirely with aircraft design, construction and operation of airplanes, a text plus an important text in the dynamics of aircraft.

**Into The Air—An E. W. Self-Pub. Newsletter**, Ltd. Toronto, England, \$3.64, 24 pp.

A study of the requirements of complete and integrated an conditioning systems in aircraft.

**Guided Missile Operations, Design and Theory**—with a foreword by Lt. Gen. Charles T. Myers, USAF, sponsored by the Department of the Air Force—Pub. McGraw-Hill Book Co., Inc., 120 West 43rd Street, New York 36, N. Y. \$8.00, 583 pp.

Highly technical book, serving as a guide and reference for all those concerned with the science and technology of guided missiles.

**The Aeroplane Designer of British Aircraft 1918**—compiled by the staff of The Aeroplane—Pub. Temple Fine Limited, Bowling Green Lane, London, E. C. 4, 3/6, net 643 pp.

This dictionary covers the British aviation field from the pioneers to the modern industry. It also includes a who's who in British aviation.

**1850 Who's Who in Electronics**—published by Electronics Productive, Inc., 2775 S. Waverland Blvd., Cleveland 23, Ohio 547.00, 680 pp.

This volume is a complete, current directory of electronic component and equipment source guide. Contains list of manufacturers, both geographical and alphabetical; producing trade names, representatives and addresses.

**Second-Rate Beams**—by Kermit Lennert, published by Doubleday & Co., 275 Madison Ave., New York, N. Y. \$1.98, 96 pp.

This book deals with the faults and fallacies of modern electronics as discussed by leading scientists, educators and practitioners.

**Research in Silent Aircraft** published by Brasco Books, Inc., 25 West 99th Street, New York 36, N. Y. \$3.35, 218 pp.

True story of the Air Research Service of the United States Air Force in 1944 by a highly qualified and not an operator who traveled more than 50,000 mi. to talk with ARS men.

## WHO'S WHERE

(Continued from page 15)

### Honors and Elections

**Wing Cmdr J. C. Shewler** of Reed Creek Air Force Photo Squadron 401 has received the McKee-Tavares Canada Trophy for his contribution to the successful and accurate mapping of the Canadian Arctic coast.

**Mr. Robert McKee**, president of Embury-RB&D, Incorporated, Toronto, has been named a director of the National Aeronautics Training Society, Washington, D. C. Mr. McKee is the first person to serve on the board.

**General Division of General Dynamics Corp.** and the Radio Corporation of America have received the Navy's Certificate of Merit, a newly created award and highest civilian honor the Navy can bestow, for outstanding service in the field of guided missile development and technology.

**Miss Backwell**, Westinghouse Electric Corp. missile engineer, has been named "woman engineer of the year" by The Society of Women Engineers. Miss Backwell is doing primary structural design work on the Polaris launching and landing system.

**Charles R. McGeorge**, president of Tuam Canada Air Lines, has been elected a Fellow of the Royal Aeronautical Society, London, England.

**Rich Richard H. Ryan** has been elected the Legion of Merit for his work at the Air Force Cambridge Research Center, Bedford, Mass. Mr. Ryan, chief of the Air Systems Division Laboratory, a recipient of the Air Force's top jet propulsion in-flight research award.

### Changes

**Donald Friedman**, general manager and technical director, International Radiant Corp., Westfield, N. Y., has Philip Wagner, manufacturing manager, A. J. Boush, Jr., chief engineer, Paul M. Moskowitz, chief designer.

**William R. Babin**, director field service department, Helman Laboratories Division, Helman Electronic Corp., Los Angeles, Michigan, resigned manager. Mr. Babin, also communications manager at Alaska, Federal Electric Corp., Fairbanks, N. J.

**Marshall A. Williams**, director of manufacturing, Jansco, Inc., Newark, N. J., has left.

**Dr. C. J. Regan**, research, ballistic missile division, Pennington Research Center, Fort Belvoir, Ill., Pennington Research Center, has announced W. C. S. Dine, associate director research, Edward Keller, associate director defense products, J. H. Howack, manager, research and development division.

**F. E. Wood**, Jr., quality manager, South Motors Division, Douglas Aircraft Co., Santa Monica, Calif.

**George E. Mackley**, general manager, Radio-Radio Amusement Institute, Princeton, N. J.

**Frank G. Willey**, manager data processing

ing field service and marketing, Data Control Systems, Inc., Oakley, Conn.

**Roy J. Stuck**, also manager propulsion systems, Defense Manufacturing Co., West City, Missouri, leaves.

**Gen H. S. Swain**, director of operations, Alcoa and the Valley Forge Lockheed Air Club, Buffalo, Calif.

**Chas W. Young**, assistant to the administrator for Jet Air Planning, Civil Aeronautics Administration, Washington, D. C. Joseph D. Blue, formerly Mr. Young's regional administrator of CAA's Fort Worth office.

**Levin A. Barry**, operations manager, Research and Development Division, Galley Chemical Co., Cedar, Pa.

**E. M. Haskings**, manager field sales and service, and J. T. Reynolds, manager field

sales, American Products Division, Crocker-Tire and Rubber Co., Mass., Ohio.

**Dr. Paul W. Latt**, chief engineer and Walter C. Latt, assistant chief engineer, Detroit Engineering, Chrysler Corp., Detroit, Mich.

**F. Donald Dillan**, director of research, Ag. Chandler Bros., West Hartford, Conn.

**Robert Tate**, assistant controller loans and service, The Wildlife Institute Co., distribution division of F. G. Hays, & Sons, Livingston Station, N. Y.

**Clarence J. Stuck**, technical adviser on air traffic control, American Manufacturers Board, Washington, D. C. Also, A. J. Rappoport, administrative officer, ANS National Aeronautics Experimentation Center, Miami, Fla., N. J.



### WHERE'S THE MAN WITH THE SLEDGE?

Propeller shaft thrust units are now (temporarily) lightened by hitting the handle of a 3-foot wrench with a bronze or lead mallet. Tightening by this "wacky" method sometimes produced a false sense of tightness. Some nuts loosened in service.

Airwork believed the natural slowness of the nut might be the problem. So they built this hydraulic nut tightener. Now thrust nuts are tightened by evenly applied force through a pre-determined arc; the exact number of degrees specified by the factory.

Result? The thrust nut stays tight — one major reason an Airwork engine remains trouble-free throughout a long service life. In spite of overhauls, the first nut in the last couple of inches maintains torque during the engine's opening life.

**Airwork**

1000 ROUTE 130  
MILLSIELE, NEW JERSEY

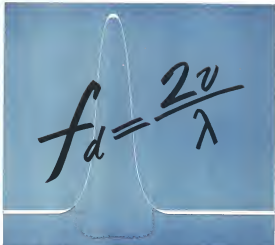
FINANCED BY  
MANUFACTURERS  
REPAIR • SERVICE • ATTACHED  
EQUIPMENT











## DOPPLER NAVIGATION SPECIALISTS

Work on advanced doppler radar navigation and guidance projects of Raytheon.

Some of the most interesting and vital projects of the day are now in the works at Raytheon's Maynard Laboratory.

Challenging assignments are open to engineers with specialized skills experience in Doppler navigation and guidance systems... and to others with backgrounds in radar interested in working with these new systems.

Are you a circuit design engineer, microwave design engineer, product design engineer, or systems engineer with radar experience?

**PLEASE CALL TODAY.** Ask for John J. O'Brien at TW-Only 7-2965, Ext. 348, or write him for details. He'll be glad to arrange an appointment at your convenience.

**RAYTHEON MANUFACTURING COMPANY**

Maynard Laboratory

P. O. Box 877, Maynard, Massachusetts



Excellent  
& Electronic

new plans to Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Service Co.** Division of 1,400 contract hours by Edward J. Verrano, office located at 1000 Avenue of the Stars, Washington, D.C.

**General Mills, Inc.** Acquisition of 40 contract hours through contract of science and electrical test equipment shown by Edward J. Verrano, office located at 1000 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 400 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.

**General Motors Corp.** Division of 1,000 contract hours by Gordon Dean office, located at 1140 Avenue of the Stars, Washington, D.C.



The CWT Control Room... As wind tunnel tests grow more complex, facilities such as these enable the CWT to deliver results of the highest reliability and accuracy.

# Wish you had a Wind Tunnel?

It's often the shortest distance  
between question and answer

**FOR AERODYNAMIC DEVELOPMENT PROBLEMS...** If you are concerned with problems of aerodynamic development, have you considered using the facilities of the CWT—the Southern California Cooperative Wind Tunnel?

Since 1945, the CWT has had an important role in the testing and development of a wide range of civilian and military aircraft and missiles. With density variable from 1/30 to 4 atmosphere, Mach numbers from 0 to 1.8, and a wide variety of instrumentation, the CWT is thoroughly competent to solve problems in such diversified fields as propellers, airships and control, lofts, flares, engine inlet and exhaust, component dynamics, internal aerodynamics, static systems, and other areas.

In addition to its five owner companies, the CWT serves a number of governmental and aircraft manufacturers throughout the country. If you would like more information regarding its facilities, you are invited to write us.



Operated by the  
California Institute of  
Technology. Owned  
by Convair, Douglas,  
Griffith, Lockheed  
and North American.

ENGINEERS—AERONAUTICAL  
AERO POWER PLANT DEVELOPMENT

*Air Force space and operational  
programs offer you  
unique professional challenge  
and opportunity  
as a civilian*

Among the myriad current and projected programs of the U. S. Air Force lies a challenge and opportunity for civilian aeronautical and aerospace plant development engineers with varying degrees of specialty and experience. There's a real catch: the research, development and maintenance essential to sustaining qualitative superiority for the operational Air Force, research and development in USRB and OCRM fields; the progression into water space and review of manned, piloted vehicles. Stimulating assignments now exist for qualified men in these categories.

As an Air Force Civilian Aeronautical or Aero Power Plant Development Engineer you:

**WORK**... in a fine creative atmosphere... with foremost men in the field... with most modern equipment and facilities... in more than one specific program... in geographic locations of your choice.

**REQUIRE**... assured income... low-cost life insurance... protection from a utility accident or firestorm and comprehensive protection from arbitrary reparation... liberal sick and vacation leave plans.

**ENJOY**... expanded scope of assignment... professional prestige and recognition... job satisfaction... participation in opening new frontiers and conquering space.

For full details mail the coupon below.

Circle on Postcard and Mail to Write to:  
Air Force Civilian Personnel Dept. AWEI  
Box 7000 Washington, D. C. 20330  
Please send me further information on U. S. Air Force Civilian Personnel opportunities.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

CHALLENGE  
SOPH  
CREATIVITY

U.S. Air  
Force

mission stages by AFTRAC & Co. Air Force contract to conduct a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

Northwest Air Force Contract to develop a study of liquid-fueled jet engines for the U. S. Air Force.

**Research and Development  
Engineers and Physicists**

Specializing in Servo, Transmitted  
Circuitry, Logical Design, Microwaves  
and Antenna, Special Purpose and  
General Purpose Computer Engineering  
(Diploma required)

**Make the most of your experience**

Work on advanced projects such as air-to-air radar, analysis and development of attack for advanced radar systems, electronic timing computers and general purpose digital computers, automatic control, checkout and test equipment, tracking systems, automatic guidance, analytical tables associated with new electro-mechanical systems.

Autonetics offers a 12-year stretch of experience in the design, development and quality maintenance of flight controls, aerial navigation, automatic control, automatic tracking controls, computer loading systems, radar systems, data processing equipment, and electro-mechanical servo systems—plus a complete flight test system, specialized engineering and production facilities.

If you have a formal education, and have sound experience in any of the fields referred to our work, just send the coupon below. Attach resume if you wish.

Mr. E. F. Banning, Autonetics  
5150 E. Imperial Highway, Downey, California  
Box 16, Downey, Please include my qualifications for the following fields:

General Guidance  Air Control  Computers  Servoing  
Digital Systems  Automatic Checkout and Test Equipment

Name \_\_\_\_\_

Home Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Home Phone \_\_\_\_\_

Diploma \_\_\_\_\_

Experience \_\_\_\_\_

**Autonetics**

A DIVISION OF THE AUTOMATIC CONTROL SYSTEMS DIVISION OF THE NEW INDUSTRIAL CO.

## MANAGER

*Technical Analysis of Nuclear Power Plants for  
Aircraft or Missile Applications*

Minimum Salary \$54,000 or More (dependent upon experience)

A new complex of technical problems is encountered in reactor systems analysis of nuclear propulsion systems for flight. The company you can lead or be led by in this field is General Electric Aircraft Division, Springfield, Mass. Contact

personnel manager and derive new technical data on systems analysis of nuclear propulsion systems for flight. The company you can lead or be led by in this field is General Electric Aircraft Division, Springfield, Mass. Contact

personnel manager and derive new technical data on systems analysis of nuclear propulsion systems for flight. The company you can lead or be led by in this field is General Electric Aircraft Division, Springfield, Mass. Contact

Write an envelope to: Mr. P. H. Chilton

AIRCRAFT NUCLEAR PROPULSION DEPT.  
**GENERAL ELECTRIC**

Box 3100, 111 South Street, Springfield, Mass.

## IBM AERONAUTICAL ENGINEERS

Aircraft Instrumentation Specialist, M.E. with experience in flight instrumentation or Aeromedical Engineering Background in aircraft instruments flight, especially in cockpit and altitude measurements flight and maintenance desirable. Through knowledge of aircraft instruments and electronic technology, must have creative talent and interest in working on new methods of aircraft instrumentation.

Aeromedical Engineer, M.E. in Aeromedical Engineering with major master's Two year experience in evaluation of altitude systems both flight and analog, sensitive techniques, reducing tactical operations and security devices. Experience in data reduction and plotting computer devices. To analyze flight and data, do qualitative analysis and solve problems of flight and instrumentation and physiology.

### Advantages of IBM

A recognized leader in the electronic computer field... state-of-the-art salary and advancement work... advancement on merit... company-paid educational expenses... broad company benefits... varying opportunities with ability and experience.

### Immediate openings at Owego, N. Y.

WRITE, including qualifications and experience, to:

Mr. P. D. Spinks, Dept. 624-B  
William Perreault Division  
IBM Corp.  
Owego, New York

**IBM**

INTERNATIONAL  
BUSINESS MACHINES  
CORPORATION

YOUR PERSONAL  
OFFICE ASSISTANT  
FOR THE  
IBM COMPANY

ANALYST AND/OR DESIGNER IN THE  
DESIGN OF AIRCRAFT AND MISSILE  
PROPULSION SYSTEMS. MUST HAVE  
A B.S. IN MECHANICAL ENGINEERING  
AND A M.S. IN AERONAUTICAL  
ENGINEERING. MUST HAVE 3-5 YEARS  
EXPERIENCE IN THE DESIGN OF  
AIRCRAFT AND MISSILE PROPULSION  
SYSTEMS.

### POSITION VACANCY

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

### POSITION VACANCY

APPROX. 1000-1500 HRS. PER YEAR. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

### JOB LINE

RESEARCH ENGINEER—AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS. MUST  
HAVE A B.S. IN MECHANICAL  
ENGINEERING AND A M.S. IN  
AERONAUTICAL ENGINEERING. MUST  
HAVE 3-5 YEARS EXPERIENCE IN  
THE DESIGN OF AIRCRAFT AND  
MISSILE PROPULSION SYSTEMS.

### CO-PILOT—MECHANIC

Large transportation device available—  
must have flight instructor's license  
and be able to handle with single, multi-  
engine and instrument rating. Applicant  
must also hold C.A.A. & R. & M. member's  
license.

WRITE: Aviation Week  
—125 S. Michigan St., CHICAGO 40, ILL.

### At Your Service . . .

The Employment Service is at your  
service in these important fields of  
"opportunities" in the selection of new  
to creative development, skills and  
available technical, scientific and  
creative specialties with the industry  
and by the publication.

## ENGINEERS

If you have been looking for an  
Employment Agency that is skilled  
in the STATE OF THE ART of Technical  
Retirement and RELIABILITY  
OF INFORMATION concerning pos-  
itions, why not communicate with  
us to cover ALL POSITIONS RE-  
TIRED

FIDELITY  
PERSONNEL SERVICE  
1212 Chestnut St. Phila. 7, Pa.

Specialists in Aviation  
and Aerospace.

## FOR RATES OR INFORMATION About Classified Advertising

Contact  
The McGraw-Hill Office  
Nearest You

ATLANTA, 3-1120 Radio Primary Bldg.  
(Atlanta 200)  
BOSTON, 6-5700  
CHICAGO, 11-2200  
CINCINNATI, 4-2100  
CLEVELAND, 4-2100  
DENVER, 3-3300  
DETROIT, 2-2100  
HOUSTON, 7-2100  
LOS ANGELES, 2-2100  
NEW YORK, 2-2100  
PHILADELPHIA, 2-2100  
SAN FRANCISCO, 4-2100  
WASHINGTON, 2-2100

## Opportunities for EXPERIENCED ENGINEERS

in advanced jet, rocket,  
thermodynamics and aerodynamics fields

The challenge and experience you can bring to a position as a Curtiss-Wright Senior Engineer in any of the above fields will determine the salary offered. In addition, there are liberal employee benefits which are part of the program of this diversified organization where individual efforts and accomplishments are quickly recognized.

Requirements include responsible experience in:

### PROPULSION SYSTEMS ENGINEERING

Analysis and design of rocket jet and rocket propulsion systems... performance analysis and component design. Analysis of advanced propulsion systems such as high energy chemical rockets, plasma jet and air rockets, with ultimate development of experimental programs.

### THERMODYNAMICS AND AERODYNAMICS

High-speed flow transfer, combustion, engine hydrodynamics, thermo-dynamics, aerodynamics. Minimum of 3 years experience desired.

### STRUCTURES ENGINEERING

Missile systems structures experience in either basic design or theoretical analysis.

### GAS TURBINE ENGINEERING

Turbo machinery design. Gas turbine controls design and analysis. Stress and vibrations analysis.

Positions are open, although not all in each category, at the following Curtiss-Wright Divisions: Atmospheric Development Corporation, Santa Barbara, California; Missile Propulsion Division, Buffalo, N. Y.; Propeller Division, Caldwell, N. J.; Research Division, Queensbury, Pennsylvania 140 miles south of State College - Pennsylvania State University; Ultra Division, Union, Michigan; and Wright Aircraft Division, Wood-Ridge, N. J.

Send detailed resume including salary requirements to:

### T. W. COONE

Mr. Engineering Recruitment, Dept. 07,  
Curtiss-Wright Corporation, Wood-Ridge, N. J.

All replies confidential

**CURTISS-WRIGHT**

CORPORATION • WOOD-RIDGE, N. J.







































# SELECTION CHART

of new counterbored, low height, standard and miniature  
ESNA/NAS self-locking nuts

Standard—550° F. (Carbon Steels)	Standard—900° F. (A286 Stainless)	Miniatures—550° F. (Carbon Steels)	Miniatures—900° F. (A286 Stainless)
 LHTE (NAS 679)	 LHTE2860	 LH1660	 79LH1660 (303 Stainless)
 LHTA51 (NAS 680)	 LHTA51-2860	 LHTA51M (NAS 697)	 LHTA51M2860
 LHTA58 (NAS 681) 100° Ctsk	 LHTA58-2860 100° Ctsk	 LHTA575M (NAS 1067)	 LHTA575M2860
 LHTA57 (NAS 682)	 LHTA57-2860	 LHTA57M (NAS 696)	 LHTA57M2860
 LHTA55 (NAS 684)	 LHTA55-2860	 LHTA55M (NAS 698)	 LHTA55M2860
 LHTA521 (NAS 686)	 LHTA521-2860	 LHTA521M (NAS 1068)	 LHTA3300
 LHTA517 (NAS 687)	 LHTA517-2860	 LHTA3575	
 LHTG51 (NAS 688-92)	 LHTG51 2860		
 LHTA54 (NAS 683) 100° Ctsk			
 LHTA35 (NAS 685) 100° Ctsk			
 LHTG55 (NAS 693-5) 100° Ctsk			

self-locking Elastic Stop® nuts which only ESNA offers as standard parts, including AN 362, 363, 364, 365 and 366 types; also special designs such as high tensile, barrel and self-aligning fasteners, all types of straight and radius gang channels and very high temperature all-metal slotted beam designs for use on jet engine applications at temperatures in a range of 1200°F.

For free copy of ESNA/NAS conversion table containing both NAS drawings and ESNA equivalents with full details, write Dept. S12-625, Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

To meet the requirements of the aircraft, missile and avionic industries for lighter-weight, reduced-dimension fasteners for elevated temperature service, ESNA has designed and is currently producing all of these new self-locking nuts. Every part conforms to NAS specifications and the entire line has full Military Services approval.

This is just a part of the complete line of



**ELASTIC STOP NUT CORPORATION  
OF AMERICA**